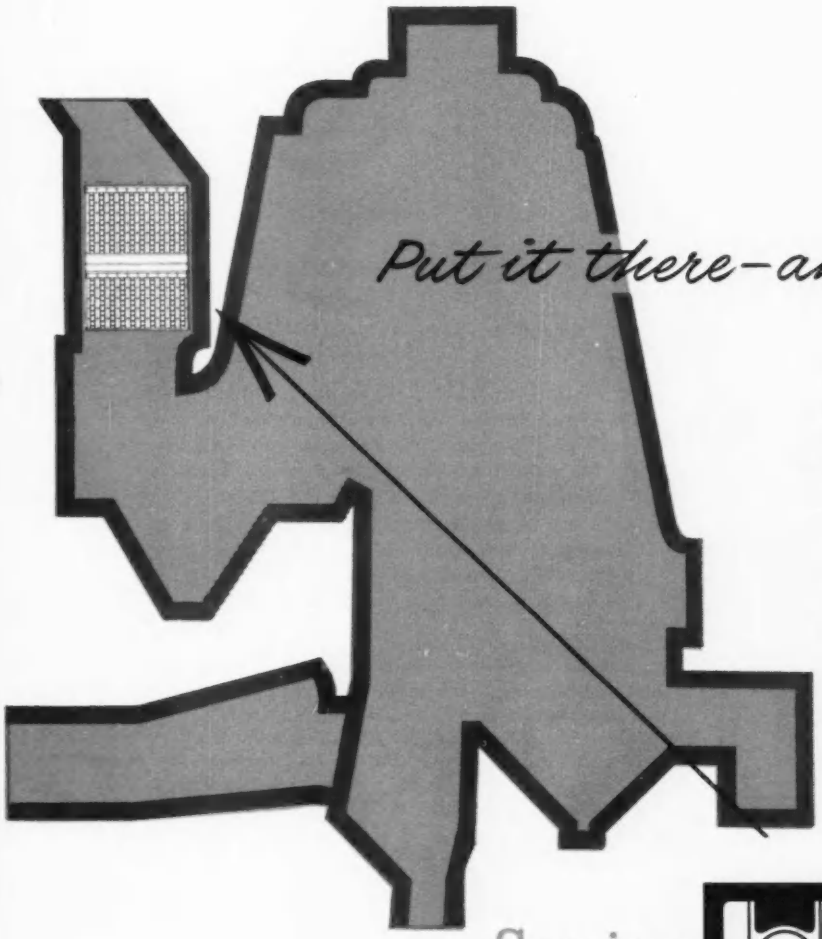
ENGINEERING AND
BOILER HOUSE REVIEW

ESTABLISHED 1899

TWO SHILLINGS & SIXPENCE

VOL. 74 NO. 9 • THE PIONEER STEAM JOURNAL • SEPTEMBER, 1959



Put it there—and **burn less fuel**

A Senior Economiser is a sound investment for every type of boiler. It will materially reduce the quantity of fuel burned to raise every pound of steam and its maintenance costs are negligible. Cast iron protected tubes give resistance to corrosion. Straight through vertical gas passages ensure maximum availability with minimum draught loss. Senior Economisers can be fitted with steam soot blowers or water washing equipment but dozens of Senior installations are working satisfactorily without either.

Senior H TUBE economisers *for cheaper steam*

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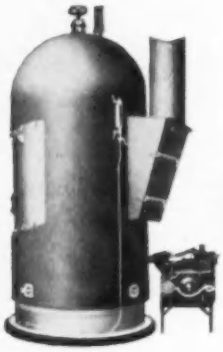
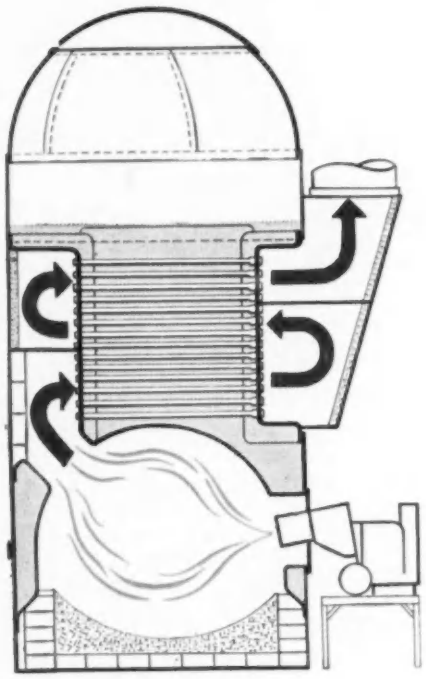
ANNOUNCING

A NEW TRADITION ?



THE NEW COCHRAN

A HIGH EFFICIENCY VERTICAL BOILER with—



- ★ **All the advantages of the well known Cochran design and construction.**
- ★ **Multi-pass design giving over 80% efficiency on the gross calorific value of the fuel.**
- ★ **Fully automatic controls with pressurised, modulating burner.**
- ★ **Readily convertible to solid fuel.**
- ★ **The important advantage, usually associated with "packaged" boilers—every boiler is steam tested and has controls set for optimum efficiency at the Works before despatch.**
- ★ **AND the Series II design gives the maximum economy of floor space**—in fact it requires only about half that required for a modern horizontal boiler of equal capacity.

All these advantages are achieved without sacrificing the essential design features of Cochran Vertical Boilers which have, over the years, shown supreme qualities of reliability and durability.

THESE BOILERS ARE ALREADY AVAILABLE IN RATINGS FROM 1,750 to 8,300 lbs. hr. from and at 212°F and an early extension of the range is planned. The Standard Range of Cochran Vertical Boilers will continue to be available.

Leaflet C.B. 94 describes the Series II boiler.

COCHRAN

COCHRAN & COMPANY, ANNAN, LIMITED, ANNAN, DUMFRIESSHIRE, SCOTLAND, ANNAN 111
And at 34 VICTORIA STREET, LONDON S.W.1. ABBEY 4'41

series II

TAS/CH670

Atomic Power Stations

Permutit have now obtained contracts for supplying "Deminrolit" plant to six Atomic Power Stations. This follows the successful installation of "Deminrolit" plant for providing feed water for heat exchangers at the world's first Atomic Power Station at Calder Hall. "Deminrolit" plant is but one of a complete range of plants designed and manufactured by Permutit to provide perfect feed water for heat exchangers and boilers of ALL types and pressures.

1 CALDER HALL A
2 CALDER HALL B
3 CHAPELCROSS
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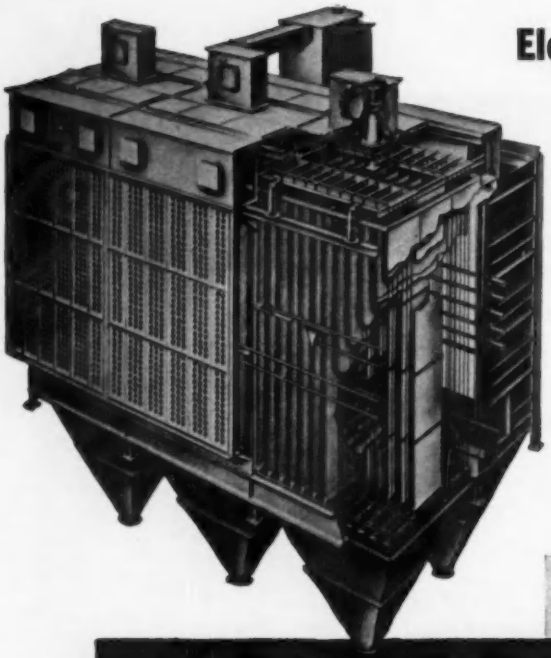
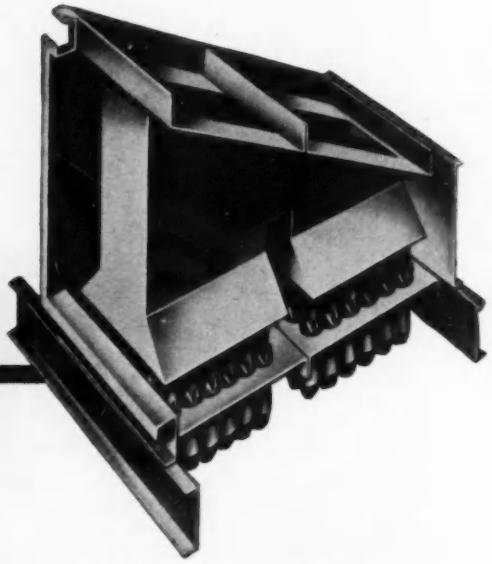


Electrostatic Precipitators

Made under licence from the Aerotec Corpn., U.S.A., these precipitators have an extremely high collection efficiency, low current consumption and many novel design features including screen-grid type collecting electrodes which minimise re-entrainment and consequent emission of dust. Manufactured in several combinations of width, height and length to suit available space in existing plants or most efficient usage of building volume in new constructions.

PD–KB



Multitubular Dust Collectors

Here is a dust collector which satisfies the ideal requirements of steam generator designers. It has a high collection efficiency at moderate resistance; maximum freedom from dust erosion; accessibility for maintenance and service; simple, low cost erection; flexibility of arrangement to meet space availability conditions. These collectors can be used in series with electrostatic precipitators and can be designed to match the precipitator inlet.

Induced & Forced Draught and Grit Arresting Fans

The product of over 75 years of experience, 'Tornado' induced and forced draught fans can handle any boiler draught requirements efficiently and reliably. The type A.R. aerofoil section backward bladed centrifugal fan, with peak efficiency of 90%, is only one of the many types (another is the combined induced draught and grit arrester) produced to deal with all classes of boilers from central heating to those in the largest power stations.

for CLEAN AIR

KEITH BLACKMAN LTD
(Incorporating Blackman Export Co Ltd)
MILL MEAD ROAD · LONDON N.17
in collaboration with Prat-Daniels (Stroud) Ltd., Whitecroft, Nailsworth, Gloucester

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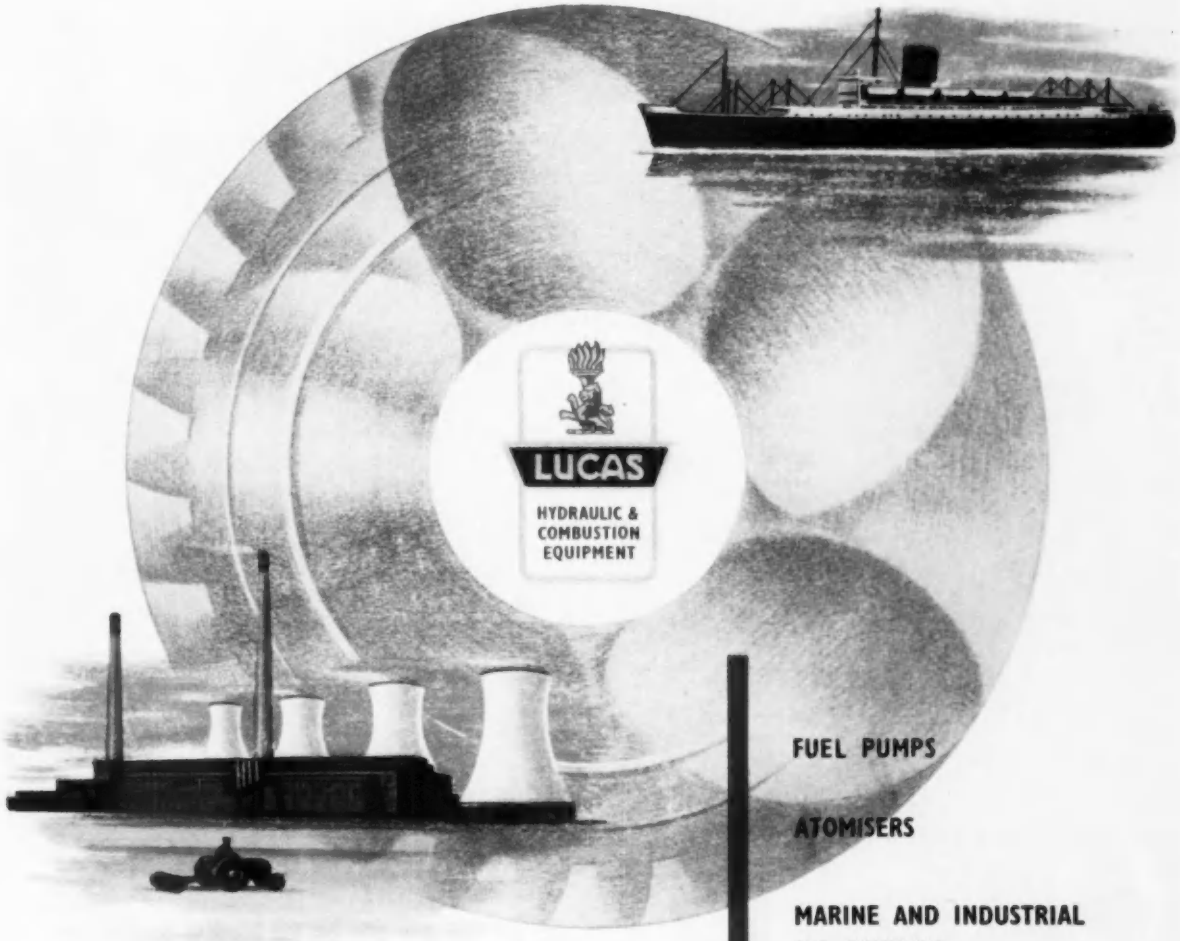
THE PRIME MOVER



FUEL PUMPS

ATOMISERS

MARINE AND INDUSTRIAL
OIL BURNING
INSTALLATIONS

HYDRAULIC TRANSMISSIONS
AND SYSTEMS

LUCAS

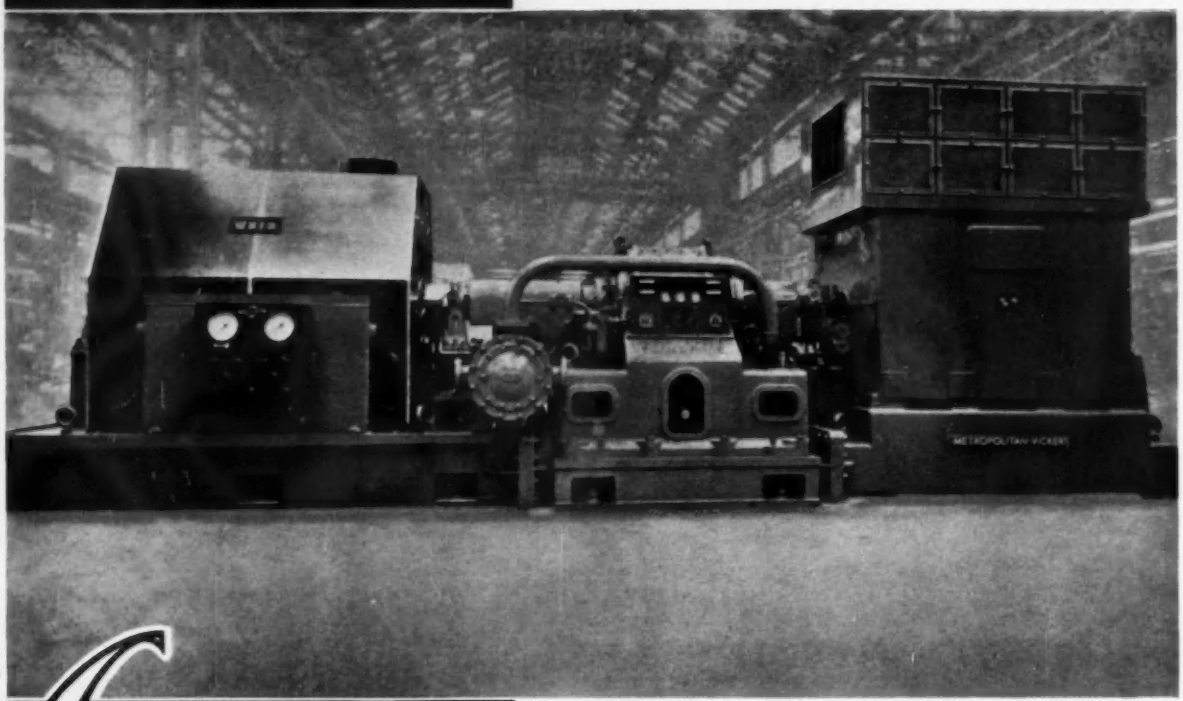
Designers and Manufacturers of High Performance Equipment

JOSEPH LUCAS (HYDRAULIC & COMBUSTION EQUIPMENT) LTD · MARSTON GREEN · BIRMINGHAM · ENGLAND

A Subsidiary Company of Joseph Lucas (Industries) Ltd.

ALSO AT TORONTO (CANADA) AND SYDNEY (AUSTRALIA)

TO FEED CANADIAN BOILERS



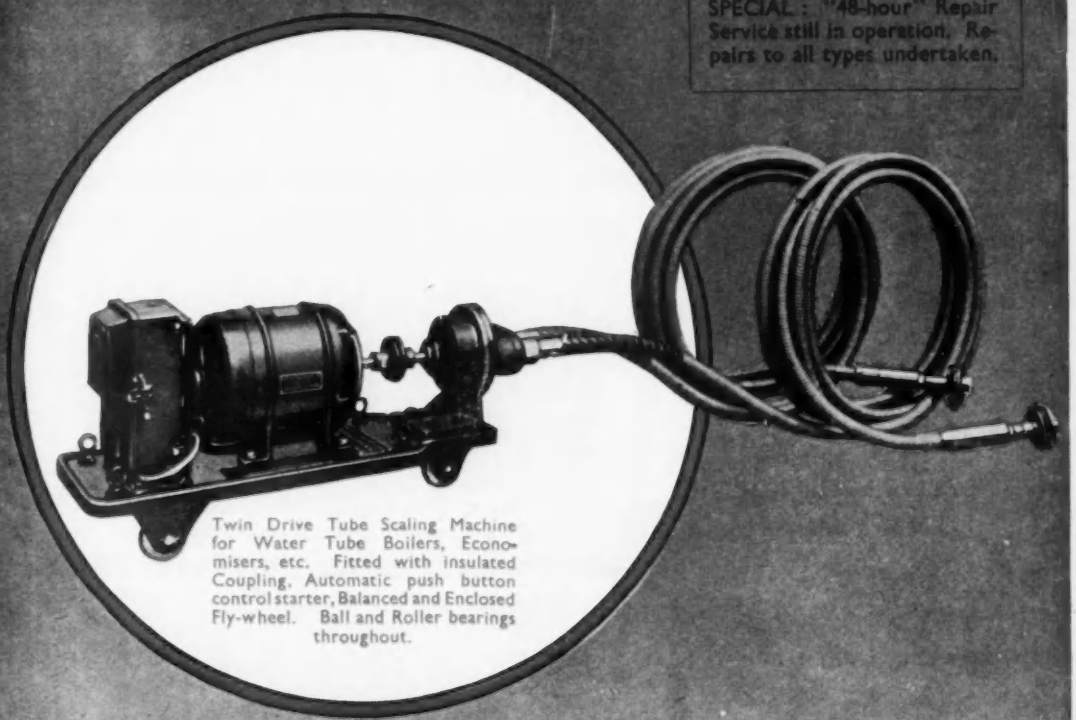
6 Weir ELECTROFEEDERS

This unit is one of six large Weir Electrofeed Pumps which are being supplied to the Hydro-Electric Power Commission of Ontario, Canada, for their new Richard L. Hearn Generating Station. It is complete with 3,000 h.p. motor and variable speed fluid coupling. Its output is 735,000 pounds (328 tons) per hour, with a discharge pressure of 2,260 p.s.i. When installed, two of these pumps will be working together, with a third as a standby, in each of the two Power Station Units 6 and 7.

Weir G. & J. WEIR LTD., CATHCART, GLASGOW, S.4

Flexible Shafts *and* Flexible Shaft Driven Tools

SPECIAL : "48-hour" Repair Service still in operation. Repairs to all types undertaken.



Twin Drive Tube Scaling Machine for Water Tube Boilers, Economisers, etc. Fitted with insulated Coupling, Automatic push button control starter, Balanced and Enclosed Fly-wheel. Ball and Roller bearings throughout.

Grinding, Polishing, Buffing, Sanding, Tube Scaling and Tube Brushing Machines, etc., etc. Manufactured throughout in our own Works. As supplied to War Office, Air Ministry, Admiralty, all leading Railways, and Industrial Organisations in all parts of the world.

THE FLEXIBLE SHAFT MANUFACTURING CO.

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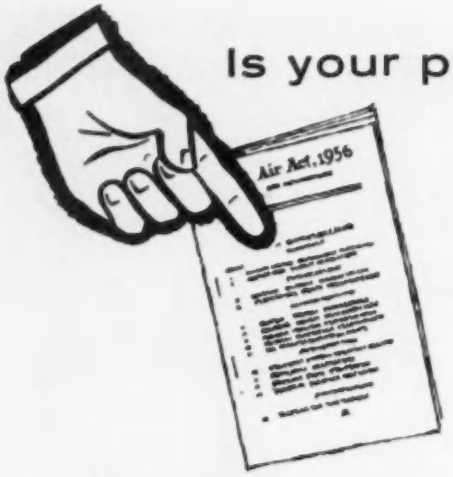
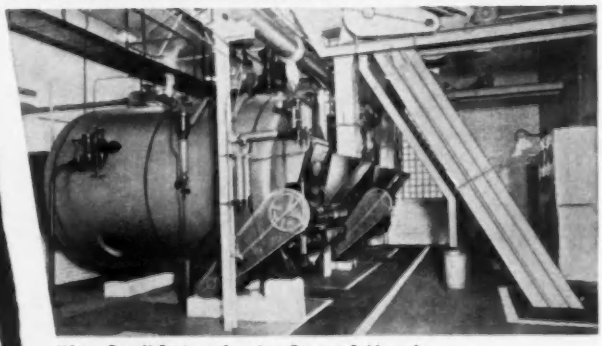


Is your problem smoke prevention?

Clearly BENNIS have the answer –in fact **two** answers!

With the CHAIN GRATE and "LOW RAM" Stokers for the firing of shell type and small water tube boilers Bennis offer two machines which give not only freedom from legislative action but a new economy. For smokeless combustion, higher thermal efficiency and fuel economy with maintenance costs reduced to a minimum, the answer is clearly BENNIS.

Bennis Chain Grate Stokers fitted to Economic boilers.



"Low Ram" Stokers fitted to Ruston & Hornsby Horizontal "Thermax" Economic boilers.

We can also supply Oil Fuel Burners and Auxiliary equipment with complete erection, pipework and storage tanks.

BENNIS
COMBUSTION LIMITED

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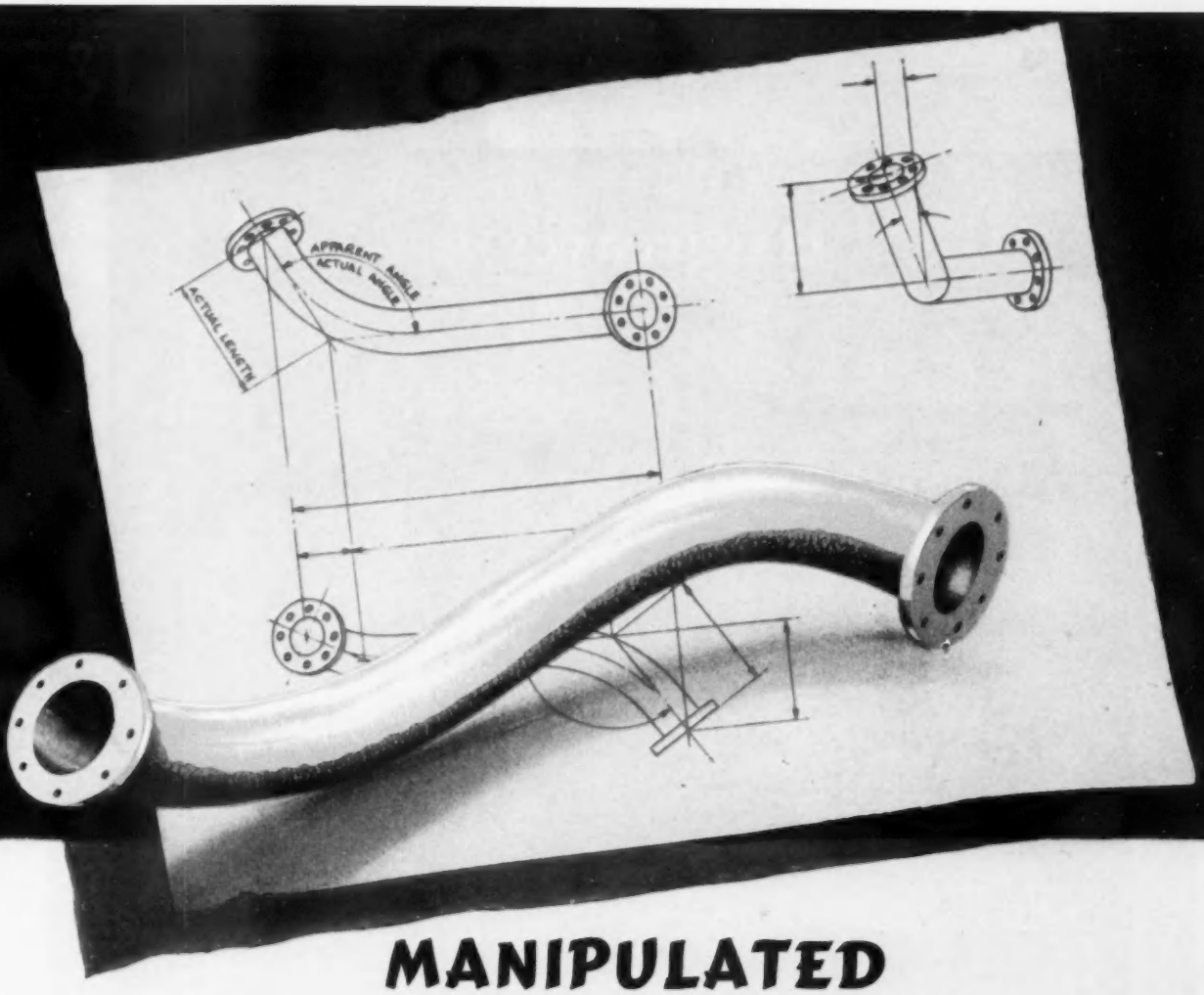

MANIPULATED PIPEWORK

Many of the orders which we receive are for large pipework installations, but many more are for only a few pipes.

Our production facilities are planned to meet all requirements and whether the order is large or small, our expert design staff is always available to help you.

There are S & L Branches in most large towns.

STEWARTS AND LLOYDS LIMITED

GLASGOW · BIRMINGHAM · LONDON

Hargreaves *in action!*

Truck-to-bunker delivery

The new HARGREAVES hopper-trucks fitted with conveyors deliver solid fuels in bulk, direct to bunker or firing floor.

This service cuts delivery and internal fuel-handling costs, and saves labour needed on other jobs. There are no obstructing piles of fuel; no dust; no mess.

HARGREAVES hopper-trucks deliver, to the required point, 7-8 tons of graded coal, or 5-6 tons of coke, in ten minutes.

HARGREAVES operate a free Technical Advisory Service, backed by comprehensive laboratory facilities, to advise upon the use of coal, coke and oil.

TAKE YOUR FUEL THE HARGREAVES WAY

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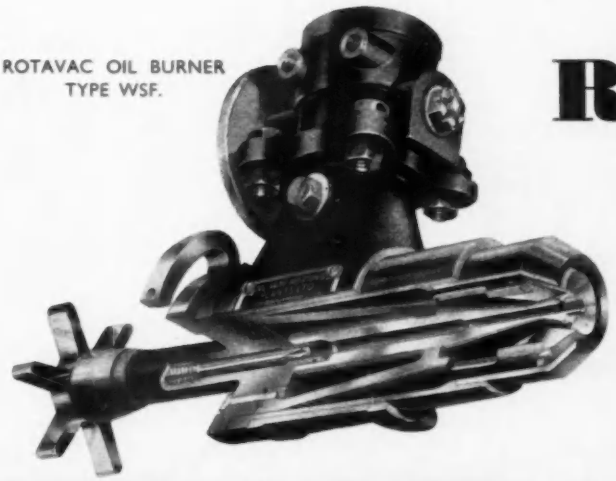


ROTAVAC OIL BURNER
TYPE WSF.

ROTAVAC
–makes boilers give their best

Photo by courtesy of Messrs. Cochran Boilers Ltd., and Messrs. T. and T. Vicars Ltd Newton le Willows.

ROTAVAC oil-firing offers—

UNSURPASSED STEAM OUTPUT per pound of fuel, year in year out, without adjustment.

ONLY ONE MOVING PART—the Fan—and that far from the flame means nothing to repair and little to maintain.

PERFECT COMBUSTION OF ANY LIQUID FUEL including the heaviest, cheapest grades. Rotavac's soft, gaseous flame is kind to brickwork and prolongs fire-box life.

ANY FORM OF CONTROL including manual, semi-automatic High/Low, or fully automatic modulation with gas-electric ignition. Send for details of ROBOT ROTAVAC—complete AUTOMATION in the Boilerhouse.

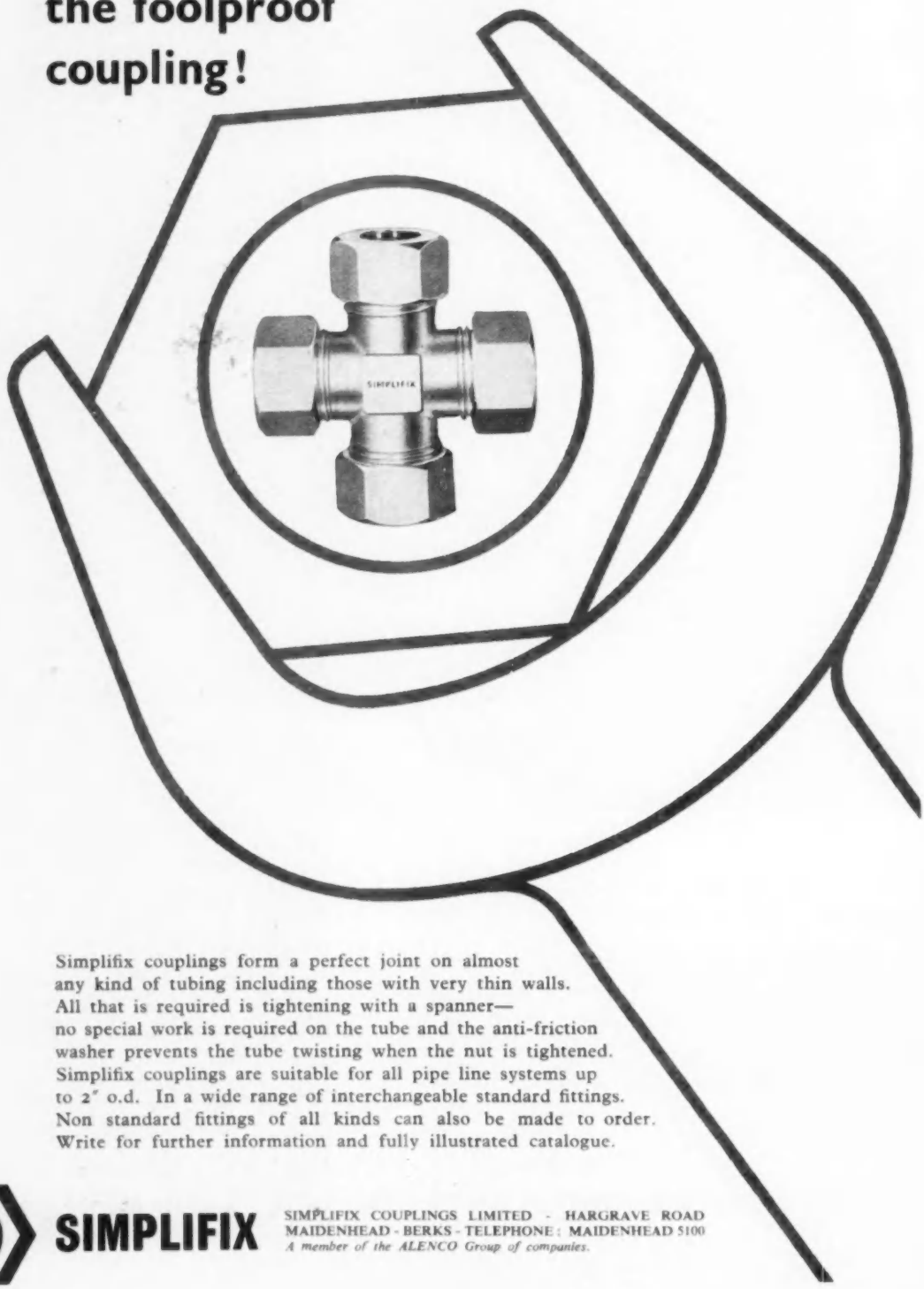
NU-WAY Oil-firing

Write now for performance details and design information to:

NU-WAY HEATING PLANTS LTD., BOX (A657) DROITWICH

So simple!

So surely SIMPLIFIX the foolproof coupling!



Simplifix couplings form a perfect joint on almost any kind of tubing including those with very thin walls. All that is required is tightening with a spanner— no special work is required on the tube and the anti-friction washer prevents the tube twisting when the nut is tightened. Simplifix couplings are suitable for all pipe line systems up to 2" o.d. In a wide range of interchangeable standard fittings. Non standard fittings of all kinds can also be made to order. Write for further information and fully illustrated catalogue.

SIMPLIFIX

SIMPLIFIX COUPLINGS LIMITED - HARGRAVE ROAD
MAIDENHEAD - BERKS - TELEPHONE: MAIDENHEAD 5100
A member of the ALENCO Group of companies.

COAL

MECHANICAL STOKERS AND THE CLEAN AIR ACT (1956)

MINISTER'S ORDER

what it means to you

IF YOUR PLANT IS SITUATED IN A SMOKE CONTROL AREA AND . . .

. . . *you are planning to install a boiler or furnace* you can now install mechanical coal-burning equipment—the most efficient method of producing the maximum heat from the minimum of solid fuel. Your plant must, of course, be properly installed, maintained and operated. *Bituminous coal may be used as fuel.*

. . . *you are using bituminous coal* you may continue to do so if your mechanical stoker was installed in 1957 or later and you maintain and operate it properly. *No application for permission from any authority is necessary.*

If your mechanical stoker was installed before 1957 and you want to continue using bituminous coal, you can apply for exemption to your Local Authority. The National Coal Board will make sure that you can get the right coal.

Remember that the cost of a modern mechanical stoker is about £1,200. For the supply of hot water heating only, the cost is as low as £300-£400.

The operating costs using coal with a mechanical stoker compare very favourably with *all other forms of heat.*

IF YOUR PLANT IS OUTSIDE A SMOKE CONTROL AREA YOU ARE NOT IMMEDIATELY AFFECTED BY THE NEW ORDER BUT . . .

. . . *If you are an industrialist* remember that your Local Authority may, *at any time*, give notice that it intends to create a Smoke Control Area where *your* factory is sited. That is why it is sound policy to plan *now* to install a mechanical stoker—the most economical method of producing heat from bituminous coal. And the National Coal Board will make sure that you can get the right coal.

If you work in the coal industry

Remember that this Order will help to create an increasing, long-term demand for bituminous coal. That, in turn, means more work for everyone connected with the production or distribution of coal.

If you are a 'man-in-the-street'

Remember that *everybody* is affected directly or indirectly by this Order. It will increase the use of coal—the home-produced fuel—under ideal conditions. The coal consumed need create as little 'smoke' as any other fuel. *Britain's smoke-free areas will stay smoke-free.*

THIS ANNOUNCEMENT IS ISSUED BY THE

NATIONAL COAL BOARD

If you have an industrial problem connected with COAL write (or 'phone) your nearest N.C.B. Regional Sales Manager

London & Southern: *Derbyshire House, St. Chad's Street, London, W.C.1 Terminus 8833*

North Midlands: *Mansfield Woodhouse, Notts. Mansfield 2500*

Midlands: *Ednam House, Dudley, Worcs. Dudley 55411*

South Wales & West of England: *Ocean Buildings, Bute Docks, Cardiff. Cardiff 31011*

Bristol Branch: *Eagle House, St. Stephens Street, Bristol, 1 Bristol 26541*

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North Western: *Kemsley House, 5/27, Withy Grove, Manchester, 4 Deansgate 7282*

Yorkshire: *Ranmoor Hall, Belgrave Road, Sheffield, 10 Sheffield 32921*

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PROOF of efficiency

SIMON-CARVES PRECIPITATORS AT C.E.G.B. POWER STATIONS

STATION	UNIT	EMISSION PER 1000 GRAINS PERMITTED UNDER GUARANTEE	EMISSION PER 1000 GRAINS MEASURED DURING TESTS
HUNCOAT	No. 1	20 GRAINS	5·7 GRAINS
HUNCOAT	No. 4	25 GRAINS	1·6 GRAINS
CHADDERTON 'B'	No. 2	20 GRAINS	5·6 GRAINS
CHADDERTON 'B'	No. 4	20 GRAINS	13·3 GRAINS
FLEETWOOD	No. 2	25 GRAINS	6·4 GRAINS
FLEETWOOD	No. 3	25 GRAINS	2·7 GRAINS
HACKNEY 'B'	No. 3	15 GRAINS	9·2 GRAINS
ROGERSTONE	No. 2	25 GRAINS	4·4 GRAINS

Based on results achieved at M.C.R. load under official acceptance test conditions.

HIGH EFFICIENCY ELECTRO-PRECIPITATION BY

Simon-Carves Ltd

SIMON ENGINEERING GROUP

STOCKPORT, ENGLAND

And at: CALCUTTA · JOHANNESBURG · SYDNEY · TORONTO

SC 199/PS

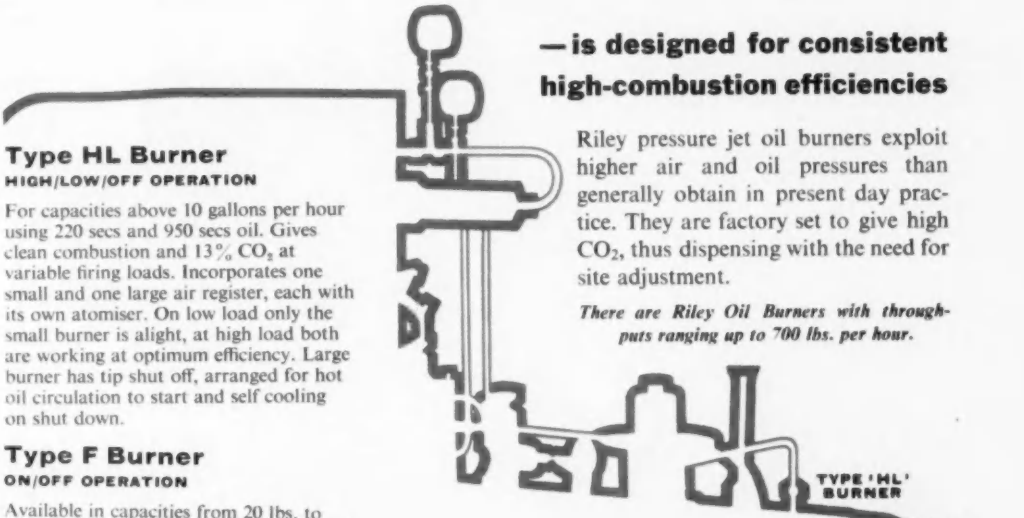
Maximum output with minimum input

Riley Oil Burning Equipment

—is designed for consistent high-combustion efficiencies

Riley pressure jet oil burners exploit higher air and oil pressures than generally obtain in present day practice. They are factory set to give high CO_2, thus dispensing with the need for site adjustment.

There are Riley Oil Burners with throughputs ranging up to 700 lbs. per hour.



Type HL Burner
HIGH/LOW/OFF OPERATION

For capacities above 10 gallons per hour using 220 secs and 950 secs oil. Gives clean combustion and 13% CO_2 at variable firing loads. Incorporates one small and one large air register, each with its own atomiser. On low load only the small burner is alight, at high load both are working at optimum efficiency. Large burner has tip shut off, arranged for hot oil circulation to start and self cooling on shut down.

Type F Burner
ON/OFF OPERATION

Available in capacities from 20 lbs. to 90 lbs. per hour, using 220 secs oil. Air/Oil ratios and pressures are factory set to give suspended intense flame with 13% CO_2, and do not require further adjustment on site.

Type G Burner
ON/OFF OPERATION

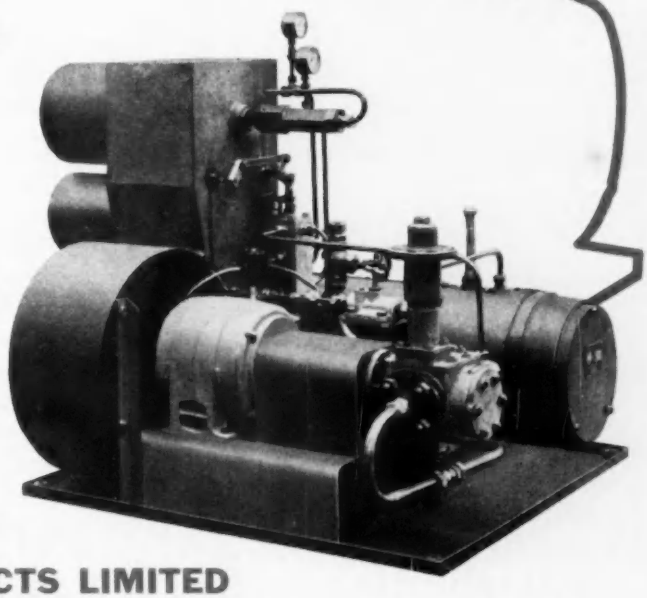
Generally similar to type F burner, but designed for use with 40 secs oil.

Type M Burner
FOR HORIZONTAL SHELL BOILERS

Spill return type atomiser with output range of 3 to 1. Specially developed air register to give clean narrow flame without impingement. Hot oil circulation to start and self cooling on shut down. Suitable for light and heavy fuel oils.

Riley Incinerators
A range of incinerators, for the disposal of rubbish and waste materials, is available. Write for full information.

For booklets giving full details of these burners, also Riley Oil Fired Combustion Chambers and Air Heaters write to:-



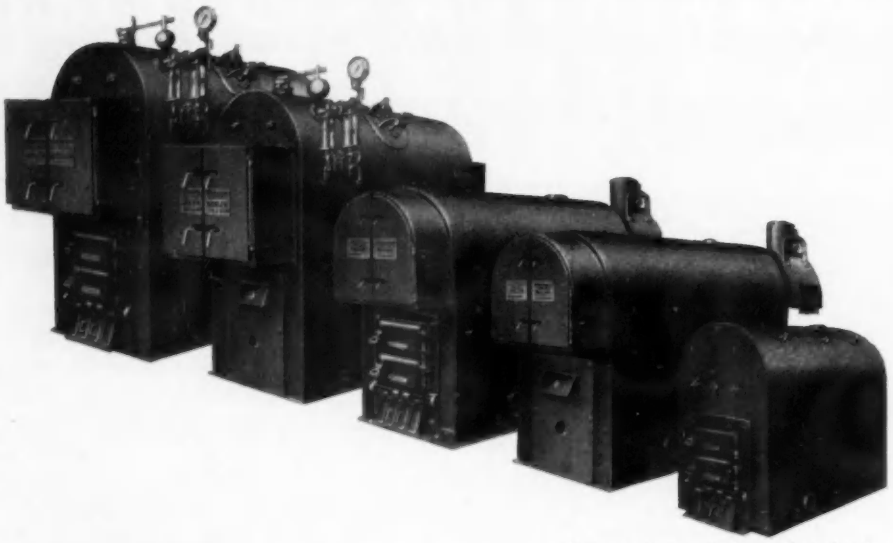
RILEY (IC) PRODUCTS LIMITED

A Member of the International Combustion Group of Companies.

NINETEEN WOBURN PLACE · LONDON · WC1 · TELEPHONE: TERMINUS 2622

Full comprehensive after-sales service is available from service depots at Birmingham, Bristol, Glasgow, Leeds, Manchester, Melton Mowbray and Newcastle-on-Tyne.

TGA RO4R



Boilers by Hartley & Sugden Ltd., Halifax

A section of copper piping showing heavy scale deposit

The same section after treatment with Starit

A Problem of Scale?

Is there a falling-off in steam raising? Do you suspect metal stress, or serious loss of heat during transfer from fuel to water? These and kindred questions in connection with boilers and feed pipes can be an indication of scale deposit that lowers the efficiency so vital to economical steam raising.

Starit effectively removes most types of scale from boilers and feed pipes, attacking and dissolving the scale to leave the metal in a first-class condition of conductivity. The action of Starit ensures rapid removal of scale deposit, but its effect on boiler plates is inhibited. Starit solution is especially effective for cleaning awkward corners impossible to reach by hand.

Starit is successful in most cases of scale deposit, but as some scale is immune to chemical treatment, send us a sample. We will then determine the suitability of Starit for your particular problem and send you a booklet dealing with the uses of Starit and methods of its application.

The solution is **STARIT**

TRADE STARIT MARK

STARIT LIMITED DARWEN · LANCS

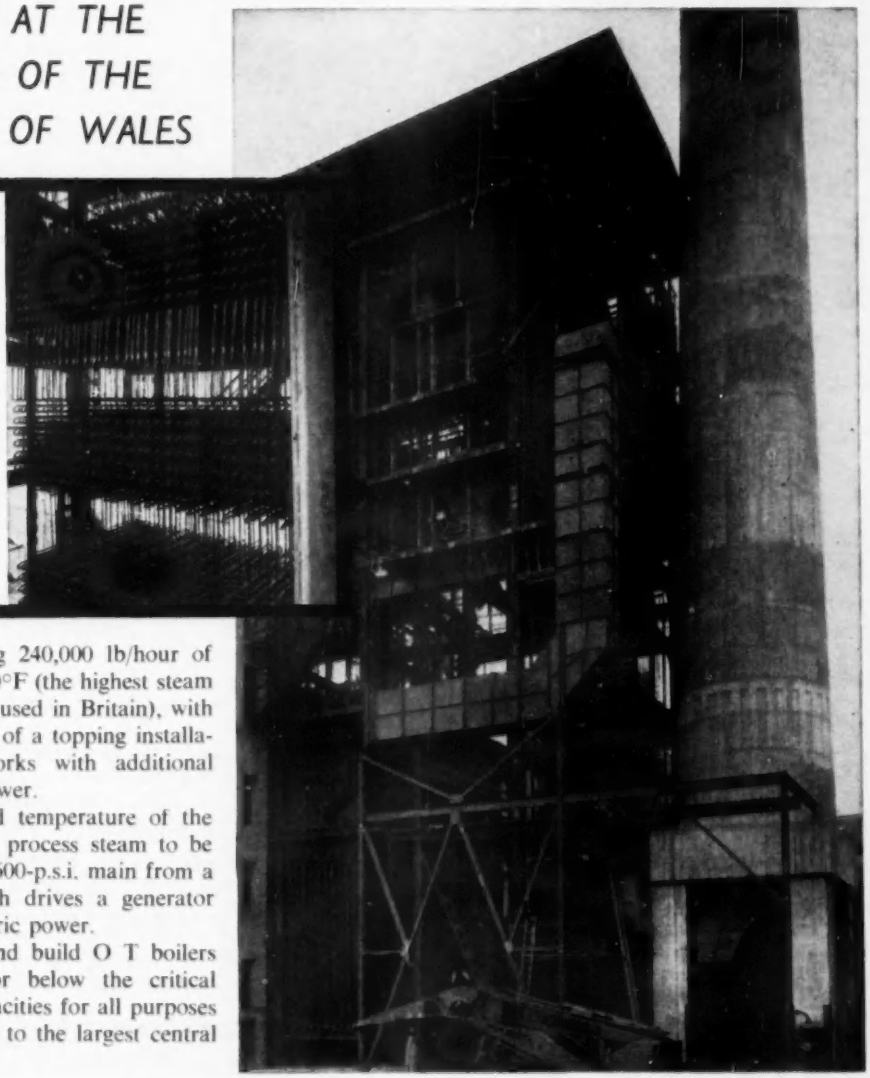
S6

BRITAIN'S FIRST

SUPER-CRITICAL

ONCE - THROUGH FORCED - CIRCULATION BOILER

HAS BEEN BUILT AT THE MARGAM WORKS OF THE STEEL COMPANY OF WALES



Main illustration. *A general view of the boiler under construction. This is an outside job, but the operating front is housed in the turbine building.*

Inset illustration. *This close-up of the top three banks of the evaporator, taken before the chamber walls were fitted, shows the type of evaporator surface.*

This O T boiler, generating 240,000 lb/hour of steam at 3300 p.s.i. and 1060°F (the highest steam conditions yet commercially used in Britain), with reheat to 840°F, forms part of a topping installation to supply the steelworks with additional process steam and electric power.

The extra-high pressure and temperature of the initial steam supply enables process steam to be exhausted into the existing 600-p.s.i. main from a back-pressure turbine, which drives a generator producing 9500 kW of electric power.

Simon-Carves can design and build O T boilers for operation above, at or below the critical pressure, with steaming capacities for all purposes from small industrial plants to the largest central power stations.

O T FORCED-CIRCULATION BOILERS BY

Simon-Carves Ltd

SIMON ENGINEERING GROUP

STOCKPORT, ENGLAND

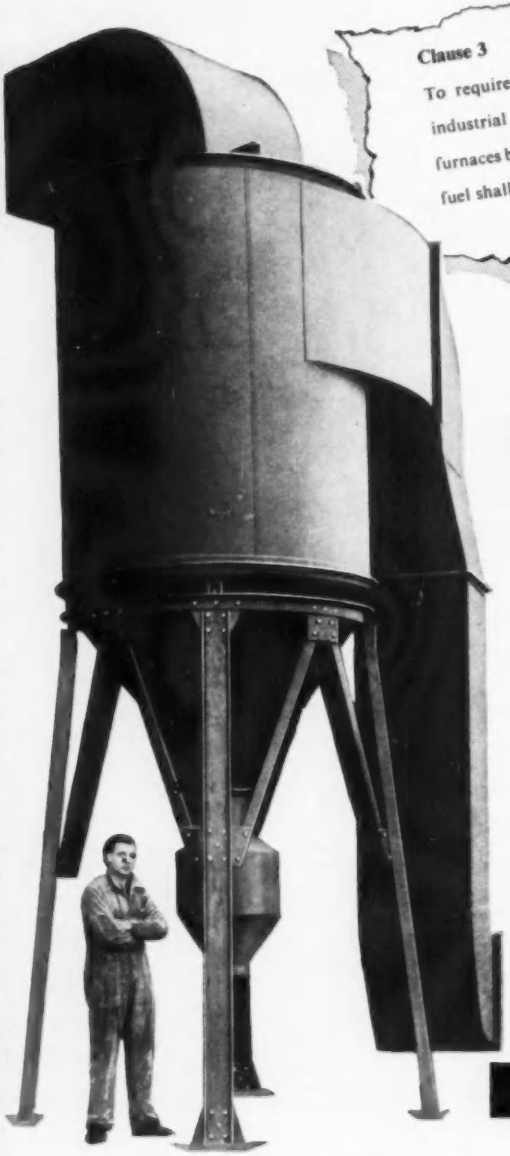
and at: CALCUTTA · JOHANNESBURG · SYDNEY · TORONTO

SC208

CLEAN AIR ACT 1956

Clause 3

To require that the emission of grit and dust from existing industrial furnaces shall be minimised and that new industrial furnaces burning pulverised fuel or large quantities of other solid fuel shall be provided with approved grit-arresting equipment.



Cyclone Patent Grit Arrester installed at Reading.

the CYCLONE GRIT ARRESTER

(Patented)

Clearly and economically meets the bill

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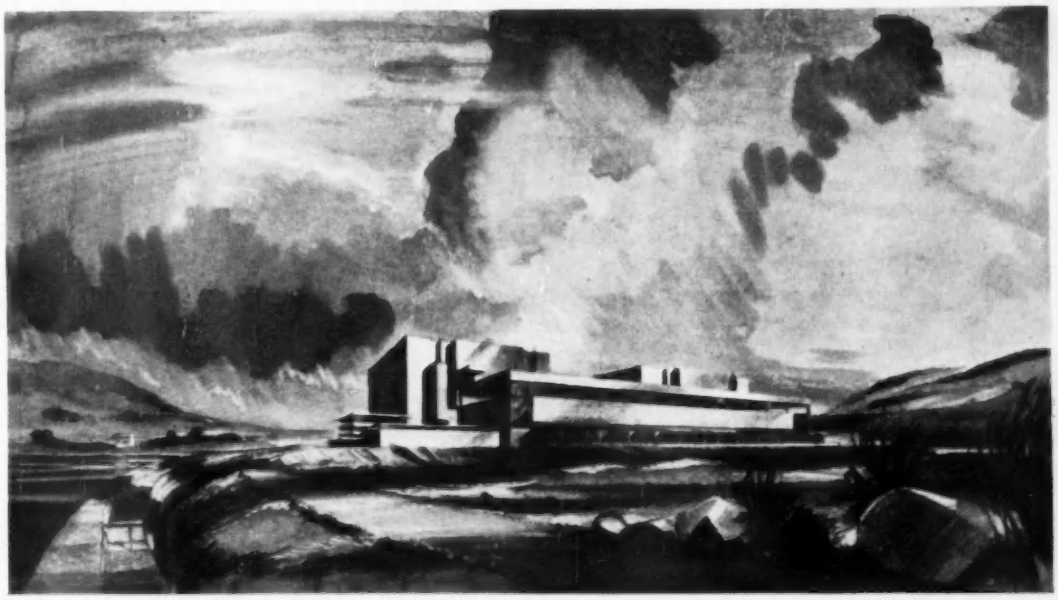
Trawsfynydd

NUCLEAR POWER STATION



This impression of Trawsfynydd Nuclear Power Station by Mr. Basil Spence, A.R.A., President R.I.B.A., Consultant Architect to Nuclear Civil Constructors, shows how the design blends into the landscape of Snowdonia

ATOMIC POWER CONSTRUCTIONS LIMITED are responsible for the design and construction of this 500 MW station for the Central Electricity Generating Board.

As a member company of **APC** International Combustion Ltd. will supply

Twelve heat exchangers

The main and recirculation CO_2 gas ducting

The biological shield cooling system

The design of the heat exchangers is based on the same practical research into methods of manufacture and operational performance as is applied to the many conventional fuel fired boiler units for which IC are responsible to the Central Electricity Generating Board.

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Steam conditions at the turbine stop valve:—

H.P. steam. .927 p.s.i.g. 715°F

L.P. steam. .290 p.s.i.g. 685°F

Steam flow ratio H.P. 65%

L.P. 35%

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G.121a

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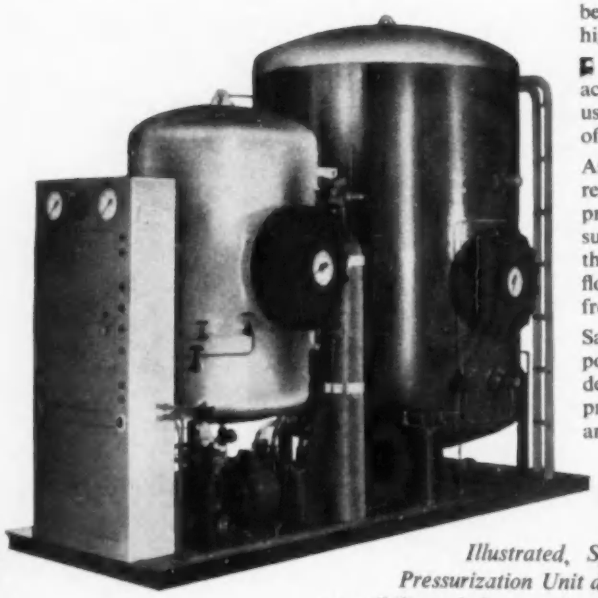

High water temperatures and greater thermal efficiency can be obtained by maintaining the water heating system at a high pressure to avoid flash-over to steam.

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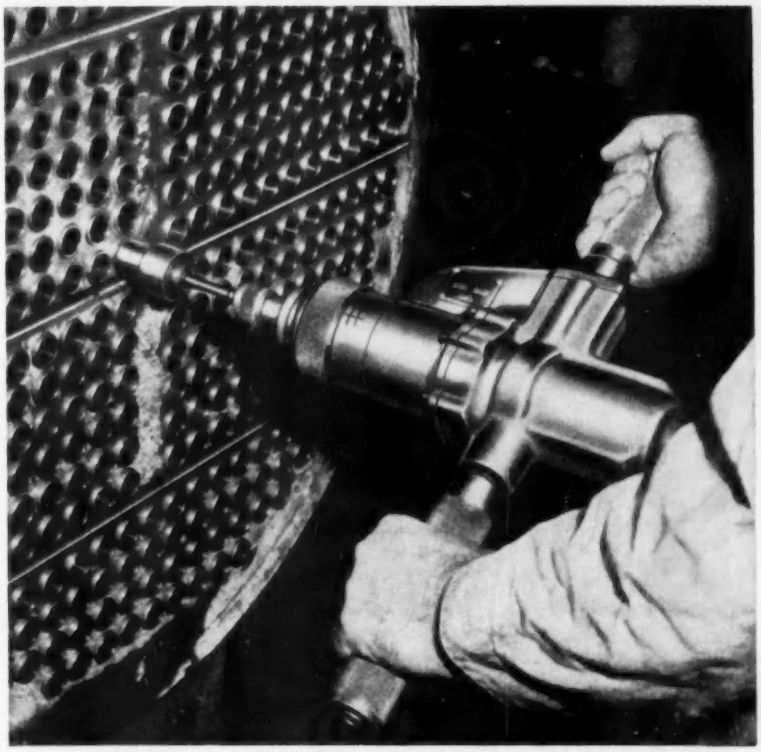

AIRETROL pneumatic tube expansion control shown. Electric systems, including retractive units, also available.

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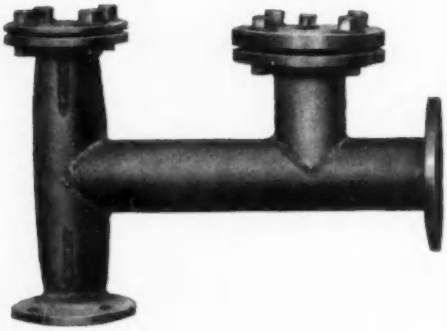

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ET 30

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If you are in a dilemma, or on the horns of it, in any matter of profitable, technically sound process steam usage, ask the Spirax old deers if they can help.

After all, most of us have grown old (well, mature) in the service of steam users. We don't know it all, but what we do know we're very happy to share. A case in point ? Well, direct steam injection.

Properly thought out, direct steam injection can be a very good way of doing a particular job. Depart from common sense and our experience, and it can be a frightfully wasteful method of heating a liquid.

To be sure, there are one or two aspects of pumping live steam into a liquid which are still not fully resolved, but the main lines are quite clear.

Before you do embark upon a direct injection technique, therefore, it's well worth picking our brains about open-end and sparge pipes, shape and size of heating tanks, automatic temperature control of inlet steam and so on.

It's quite easy to do this, because we've just produced our latest Information Sheet, which is called " Direct steam injection."

It'll surprise us if dilemma hunters don't track down a good many free copies. Care to prove us right ?

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remove the toughest deposit

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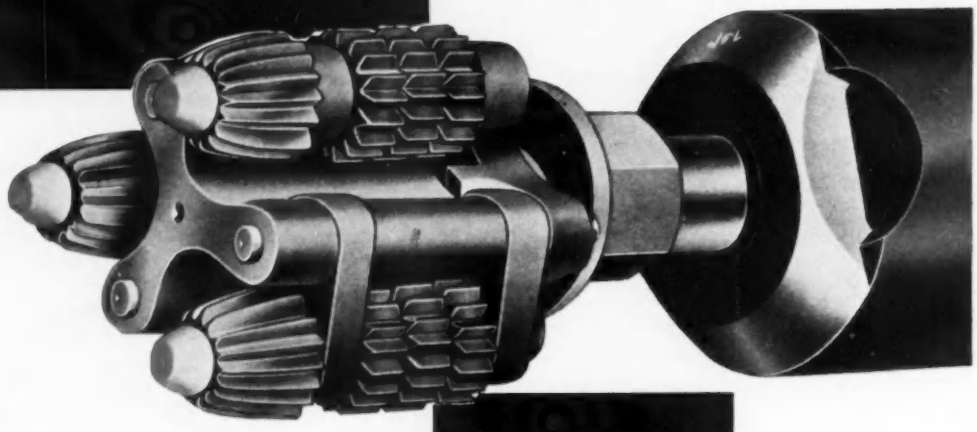
Of course a head like this takes a lot of drive to get the best out of it. This is where the powerful Lagonda motors come in, with double ball thrust bearings and full lubrication that let practically all the power through to the cutter head. The full range of Lagonda tube cleaners caters for all types of deposits in tubes straight or curved, from ½" dia. upwards. Write for Catalogue Y-48.



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CP. 182

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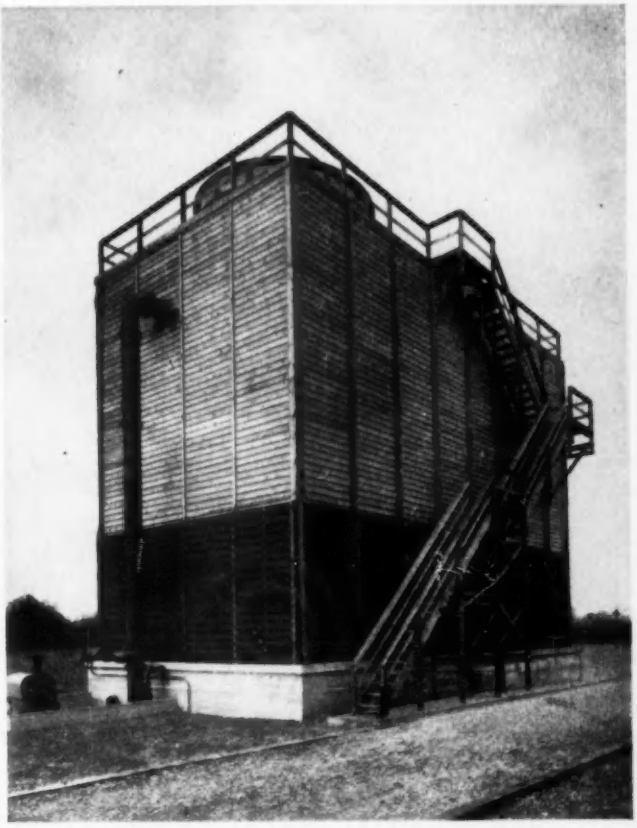

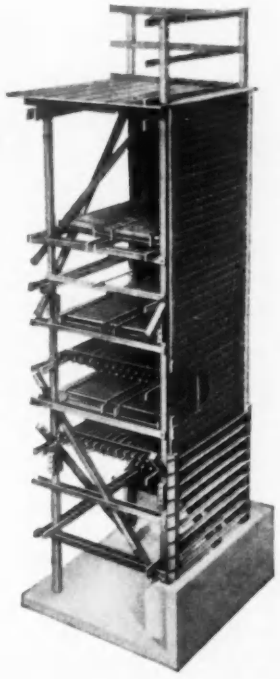

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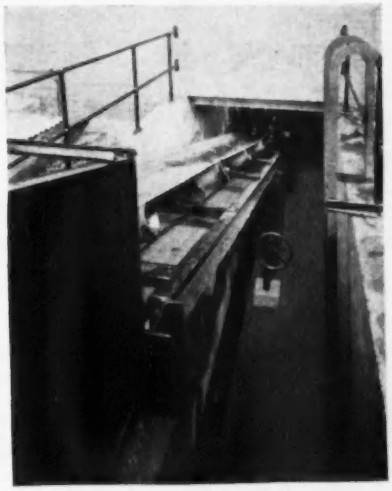
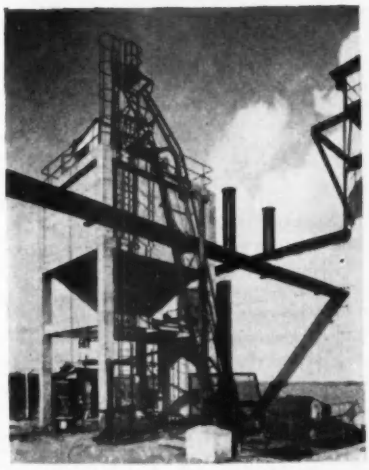
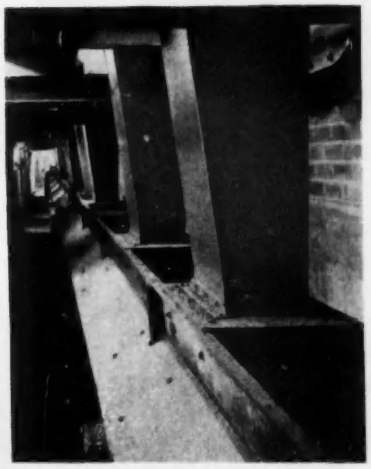


The discharge end of the submerged conveyor belt emerging from the trough.



Ash handling from the discharge end of the conveyor to the storage hopper



The trough with submerged belt, showing the ash chutes from the boilers.

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CP/11

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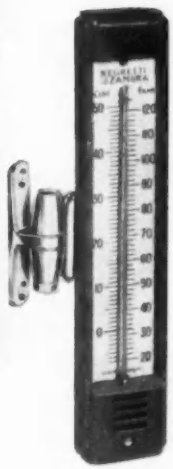

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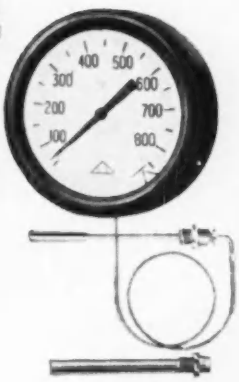
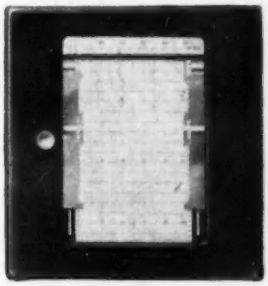
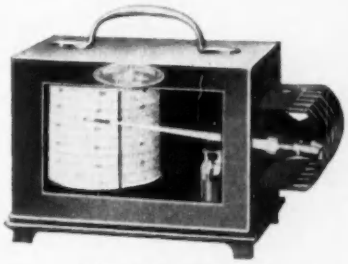


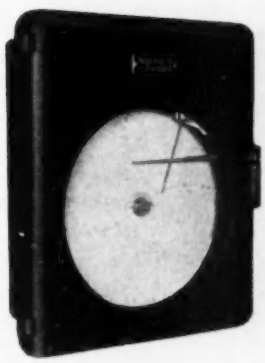
Distance-type Mercury-in-
steel Dial Thermometer



Resistance Thermometer
Recorder



Bi-metallic Recording
Thermometer



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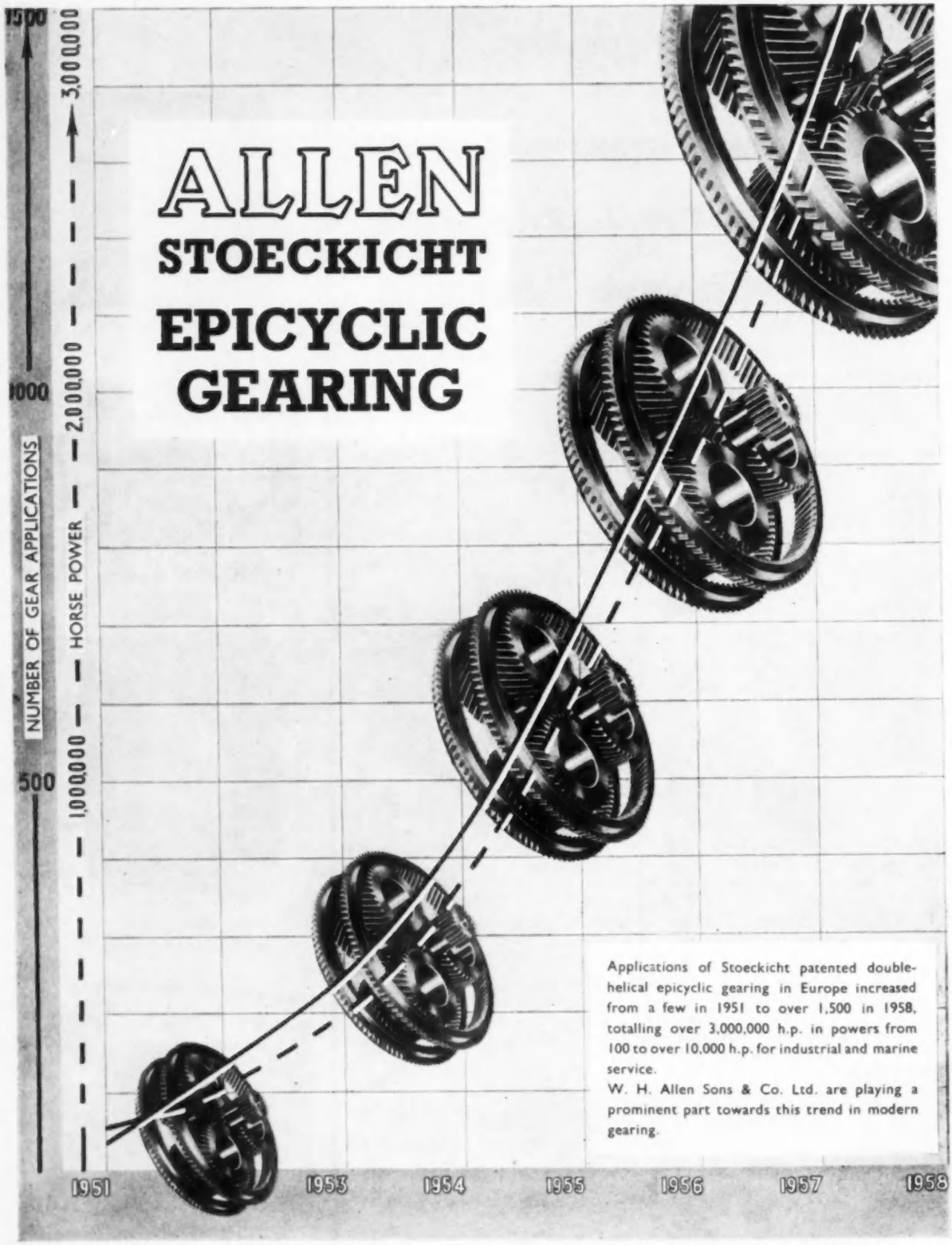

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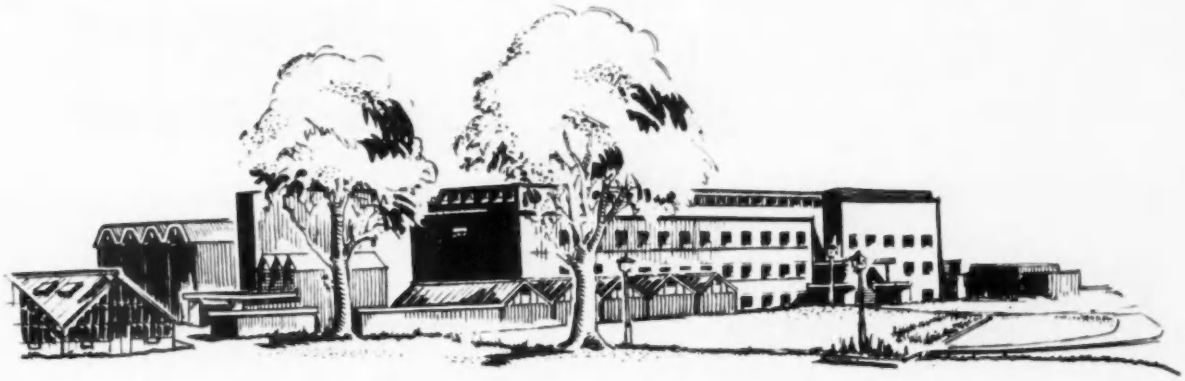

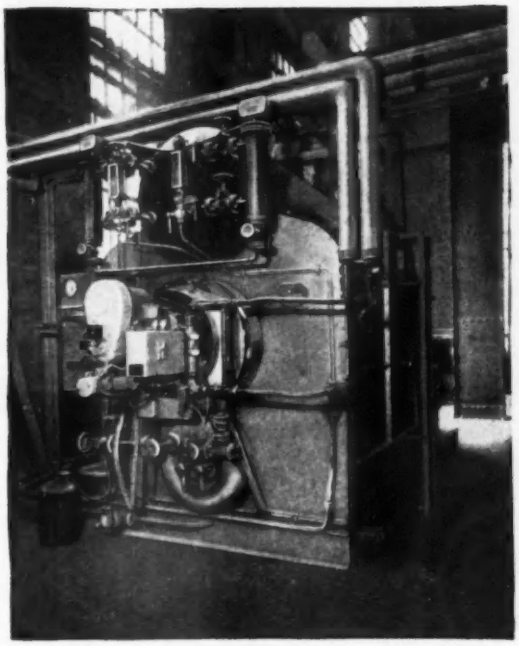

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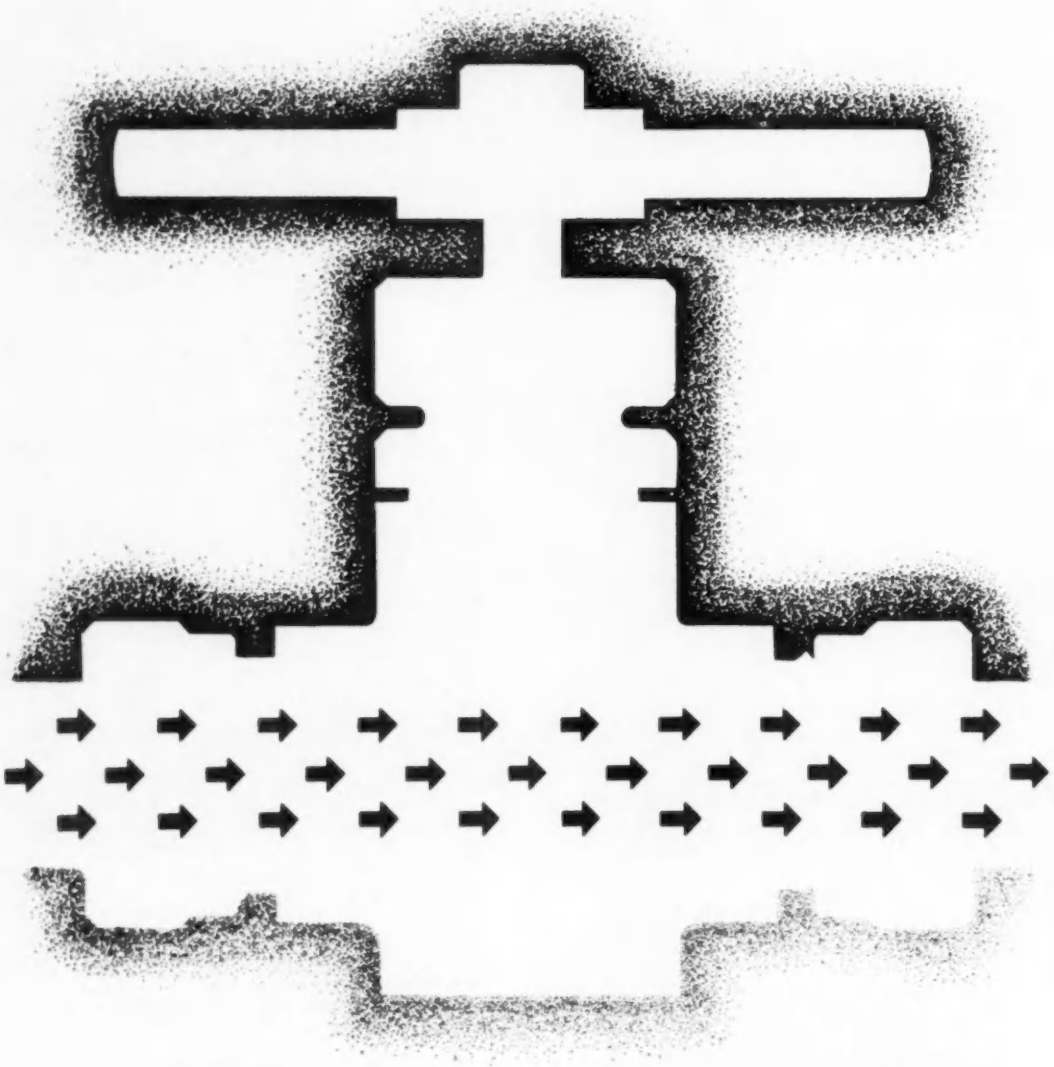

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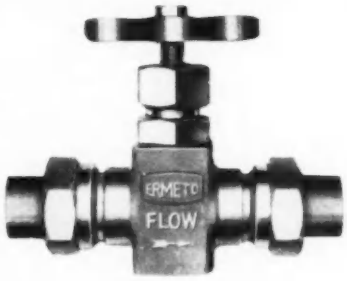

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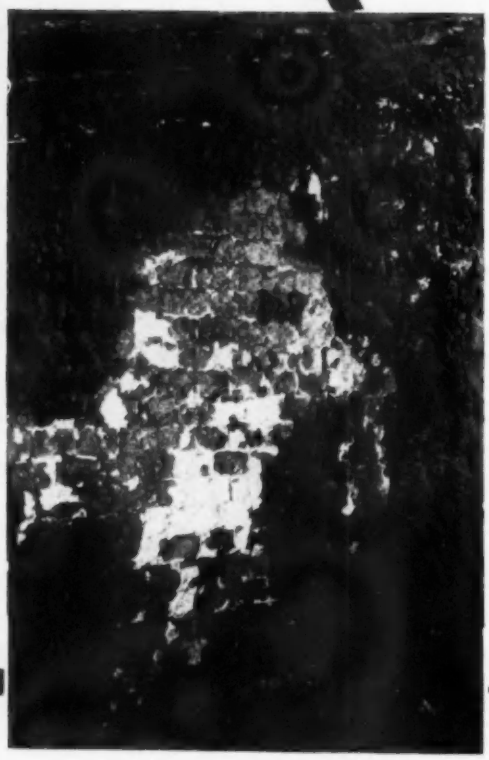

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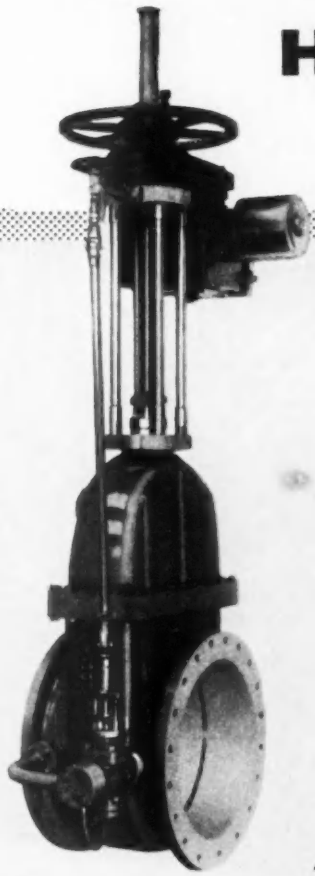

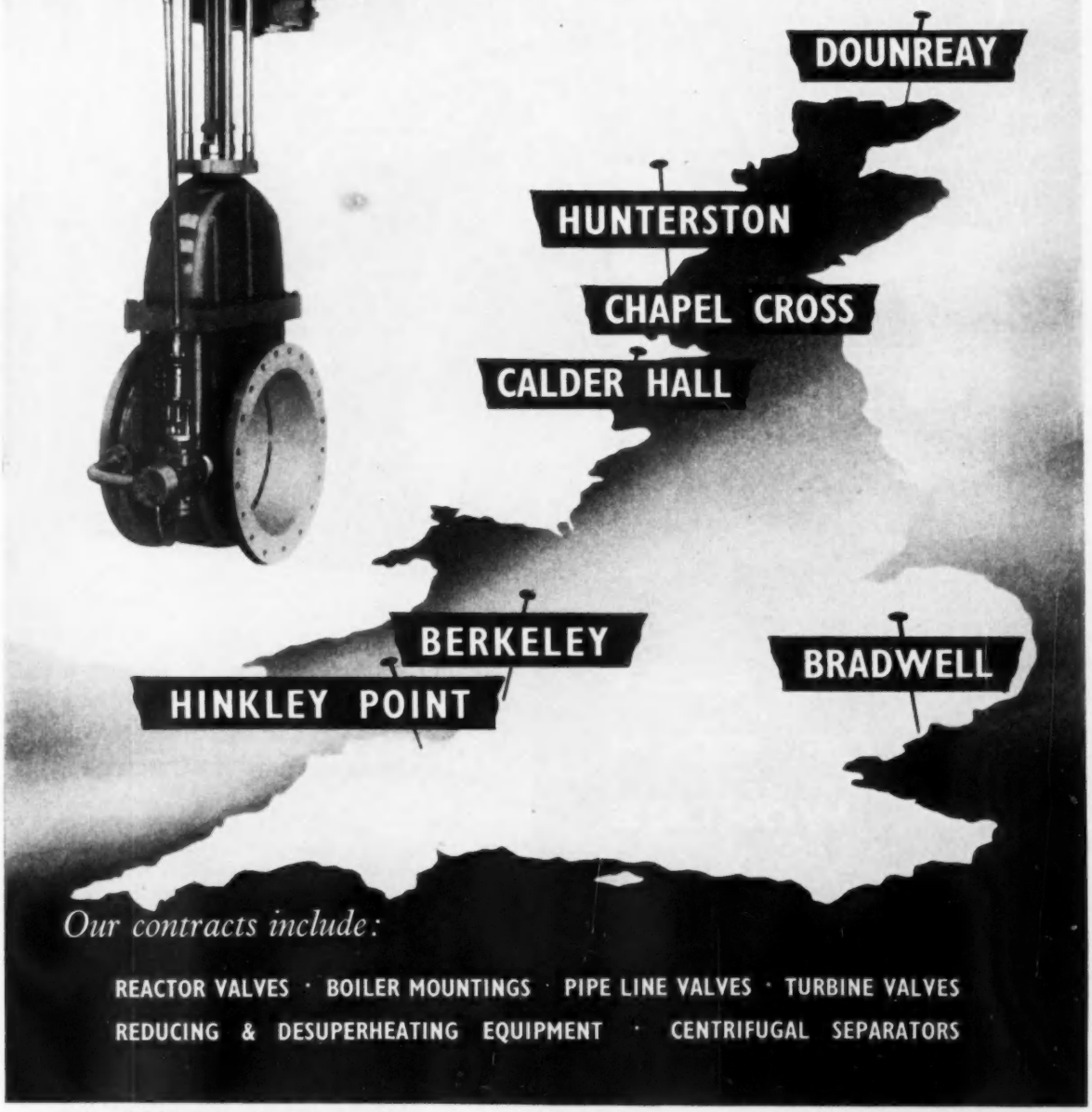

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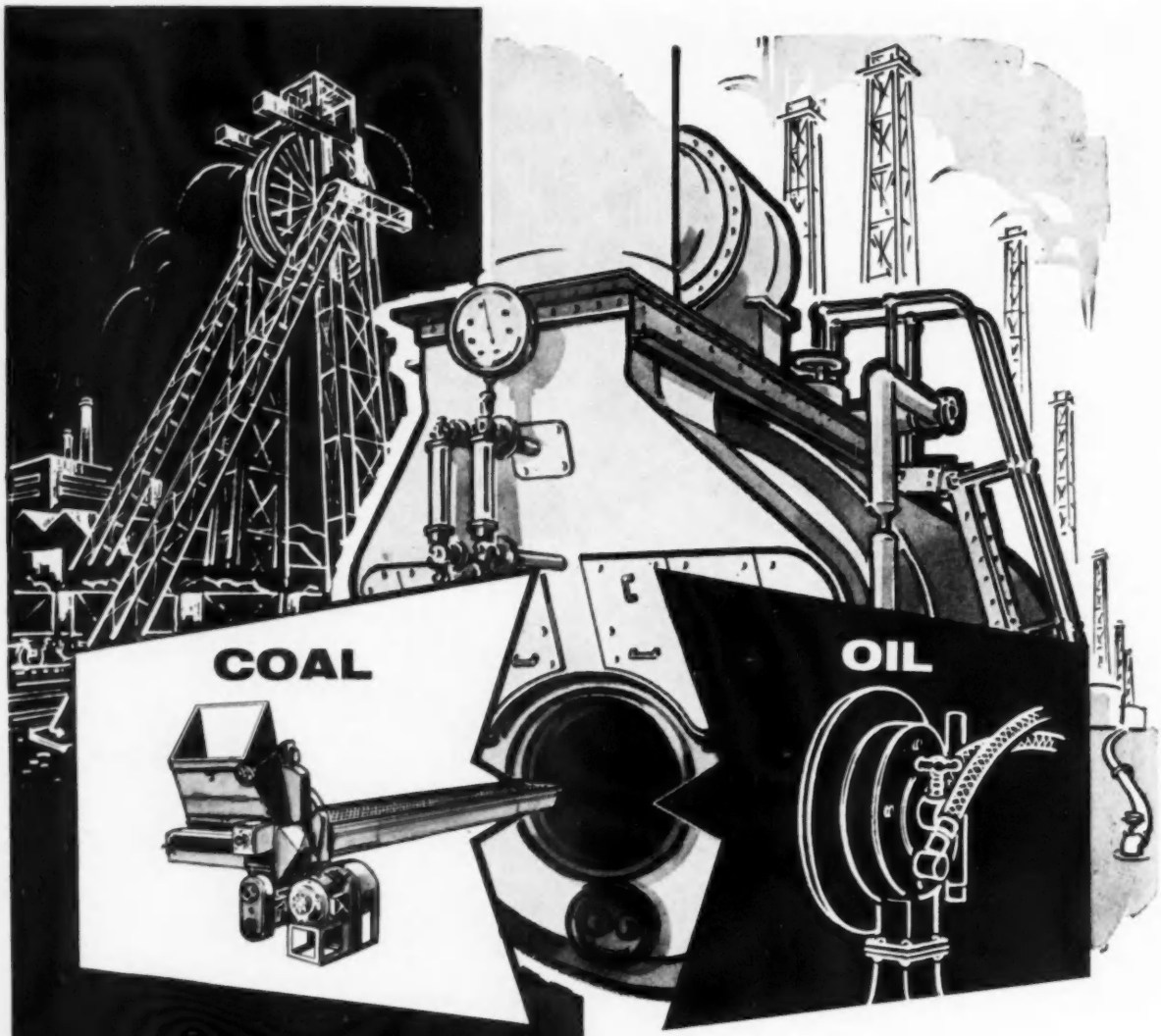

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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

SEPTEMBER 1959

VOLUME 74. No. 9

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The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

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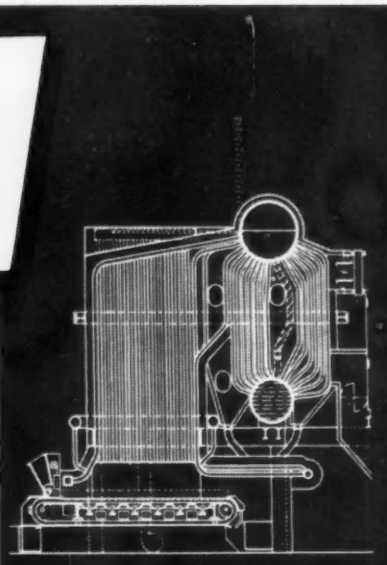
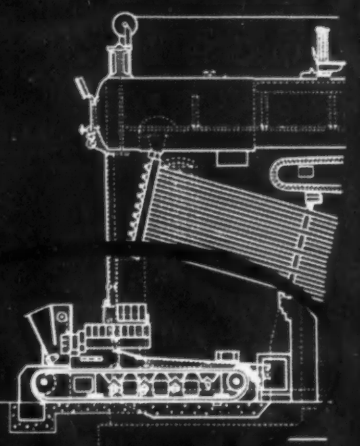
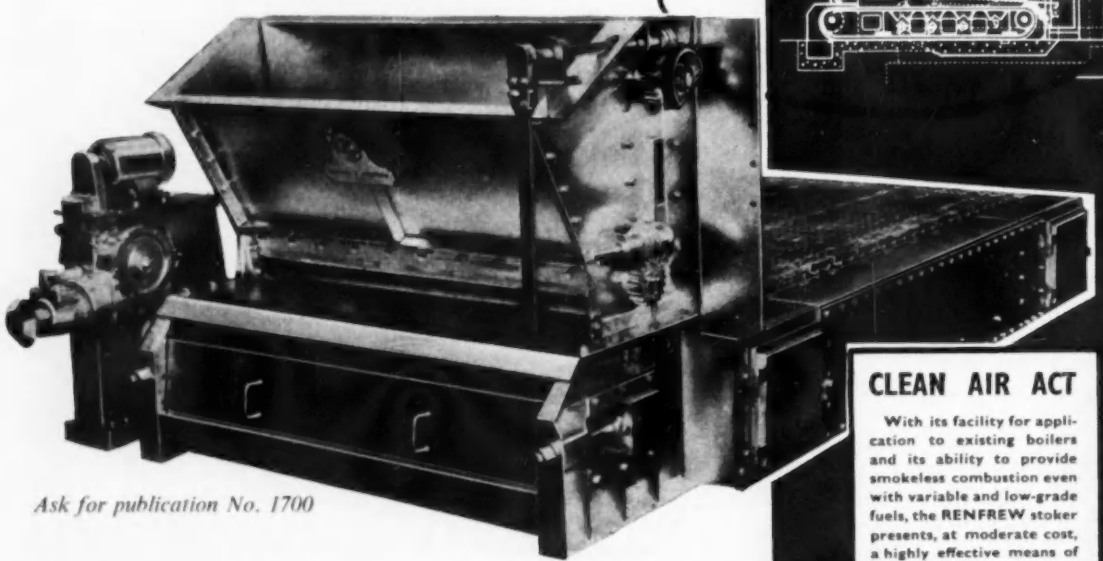




Illustrations: Above, Bi-drum boiler equipped with Renfrew stoker. Right, Renfrew stoker applied to existing, hand-fired water-tube boiler.



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SEPTEMBER 1959

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INDUSTRIAL FUEL EFFICIENCY

AT the fifth annual general meeting of the National Industrial Fuel Efficiency Service, which was held in London on September 17th, the chairman, Sir Leslie Hollinghurst, G.B.E., K.C.B., D.F.C., said that the value of the organisation's work was increasing every year. After five years of intense but rewarding effort they now have the certainty that their services are both valued and valuable, not only in the sphere of fuel efficiency itself, but also in terms of production and the quality of the product. The services of N.I.F.E.S. engineers last year, Sir Leslie remarked, were even more in demand than hitherto in those sections of industry which were the hardest pressed. Visits to works, factories and other establishments last year, for all services, numbered 12,749—this figure representing a 10 per cent. increase on the preceeding year. Five hundred and ninety-eight heat and power surveys were conducted, as against five hundred and three, last year.

Sir Leslie went on to say that the experience gained by N.I.F.E.S. during its first five years, had made it perfectly plain that there was great scope for the work to be of very real service to British industry. Experience and investigations had shown that the average factory, consuming from 500 to 5,000-tons of fuel yearly, could readily reduce its fuel costs by 15 to 20 per cent. Previous surveys had demonstrated beyond any doubt that the efficiency with which coal was being burnt under industrial boilers was very low; the survey of last year showed how the efficiency of those same plants had been raised and how it was being maintained at a much higher level under N.I.F.E.S. regular service. That, Sir Leslie claimed, was entirely due to the expert engineering control provided by the organisation in circumstances where it would be uneconomic for the industrialist to employ his own specialist staff. Such savings in fuel costs, obviously, are of importance in keeping the national economy stable, now inflation had been contained.

It appears that the best coverage by the work of N.I.F.E.S. is of the textile industry, including the leather and clothing trades, the Service having worked in 918 large factories. It is, however, disappointing to note that a number of major industrial users of fuel had not availed themselves to any appreciable extent of the Service's help and advice. For example, in the iron and steel industries N.I.F.E.S. was called upon by only 129 establishments. These industries had hardly used the Service at all prior to last year, but however, during the year, N.I.F.E.S. had done more work for them than in the four preceeding years combined. Other major industries, such as the cement industry, the brick and tile industry, and the mines and quarries outside those of the National Coal Board, have not to any extent invited the help or assistance proffered by N.I.F.E.S.

Sir Leslie said he appreciated of course, that in many case those who have not called on their Service, are efficient users of fuel, who may well employ their own fuel engineers. But at the same time, experience has proved that N.I.F.E.S. can be of help to even the most efficient in their efforts towards still greater efficiency and economy, and he hoped that their total coverage of industry will increase even more rapidly as the value of N.I.F.E.S. becomes much more widely appreciated. He was, however, amazed that, despite the great progress made by the Service in five years of intense effort, only about one in eight of Britain's factories has asked N.I.F.E.S. to make detailed investigations.

Whatever the cause of this neglect, and it is indeed a neglect of duty by some seven-eighths of industrial fuel consumers, it should be stressed that the service is fully geared to take on much more work for British industry. The Service earned nearly £166,000 in fees last year—£43,000 more than in the previous year. N.I.F.E.S. is a non-profit-making organisation, which has both the facilities and the ability, but these can only be fully effective if industrialists will themselves realise that there is this problem of fuel wastage, and that in the Service they have at their call, the means with which it can be solved.

Points and Pointers

THE BRITISH COAL UTILISATION RESEARCH ASSOCIATION Sir Eric Rideal, M.B.E., D.Sc., F.R.S., has accepted council's invitation to deliver the B.C.U.R.A. 8th Coal Science Lecture at the Institution of Civil Engineers at 5.30 p.m. on October 14th. For his subject he has chosen "Coal: A Colloid and a Chemical." Sir Eric is now Visiting Lecturer at the Imperial College of Science and Technology, and a Fellow of Trinity Hall, Cambridge. Educated at Oundle, and Trinity Hall, Cambridge, Sir Eric afterwards studied at the University of Bonn where he was awarded the degree of Doctor of Philosophy. Following active service in the first world war he joined the Munitions Inventions Board where he was engaged upon research into the fixation of atmospheric nitrogen. After the war came a period during which he was a part-time lecturer at University College, London, and then Visiting Professor of Physical Chemistry at the University of Illinois. In 1930 he was appointed Professor of Colloid Science in the University of Cambridge, a post that he held until 1946. From 1946 to 1949 Sir Eric occupied the Fullerian Chair of Chemistry at the Royal Institution, and was Director of the Davy Faraday Research Laboratory. In 1950 he was appointed Professor of Physical Chemistry at King's College, University of London, and retired in 1955. During his distinguished career Sir Eric has held many other offices including the Presidency of the Faraday Society (1938-1945), of the Society of Chemical Industry (1944-46), and of the Chemical Society (1950-52); he was also chairman of the Advisory Council on Scientific Research and Technical Development, Ministry of Supply, from 1953 to 1958. He was elected a Fellow of the Royal Society in 1930, and received the society's Davy Medal in 1951, the year in which he was knighted.

ELECTRICITY SUPPLY IN THE UNITED KINGDOM Comprehensive and detailed information concerning the fuel and power industries in the United Kingdom is given in the "Ministry of Power Statistical Digest 1958." (Published by H.M. Stationery Office, £1 17s. 6d.) Of the 123 tables in the 160-page "Digest," 18 relate to electricity supply, covering generation, output, plant installed, fuel used, thermal efficiency, works costs, capital expenditure, energy sales and appliance sales. In a certain number of cases the latest figures available are those for 1957. Returns published by the Ministry earlier this year showed that 98,500 million kWh was generated (92,687 million kWh sent out) by public supply authorities in Great Britain. In addition, details were published of generation in certain industrial power stations amounting to 10,423 million kWh. The "Digest" now gives the total kWh sent out in the United Kingdom, including Northern Ireland, as 107,015 million kWh, compared with 99,967 million kWh in 1957, an increase of slightly more than 7 per cent. Excluding Northern Ireland, sales in 1958 totalled 83,869 million kWh compared with 77,218 million kWh in 1957 and 73,520 million kWh in 1956. The largest increase was in domestic and farm supplies which rose by 3,377 million kWh to 28,227 million kWh. Sales for all purposes, excluding traction, averaged 4,893 million kWh per consumer last year, compared with 4,594 million kWh in 1957 and, per head of the population, 1,668 million kWh (against 1,543 million kWh). These latter figures including sales for public lighting and traction. The fuel industries and railway and transport authorities are not included in the analysis of industrial generation published each month. The relevant table in the "Digest" however, gives the following figures for generation outside the public electricity supply system for 1957 (million kWh):—coal mining, 1,221; gas supply, 141; mineral oil refining, 254; and railway and transport electricity undertakings, 1,208; making a total of 2,824.

FUEL ECONOMY AT COLLIERIES More than 1,000 students have now passed City and Guilds examinations in fuel efficiency under a novel system of training set up by the National Coal Board seven years ago. No less than 905 have received the boiler operator's certificate; 83 the intermediate grade certificate in boilerhouse practice; 30 the final grade in boiler house practice, and four have passed the examinations in combustion engineering. Training for the boiler operator's certificate was devised so that men on shift work could take full advantage of it, and the course consists of seven months' home study through weekly correspondence, and one full-day a month in which the students discuss their theoretical work and do practical demonstration under the supervision of a trained engineer. The correspondence course is arranged through the College of Fuel Technology, and the practical work is supervised by the board engineers; the examination is open for boiler operators and chargemen who have had 1,000 hours' boiler firing experience. When this primary course became established, students were in turn introduced to the Intermediate Grade boilerhouse practice course which covers more advanced theoretical knowledge of different types of boiler plant, and later to the Final Grade designed for chemists, engineers and for boilerhouse foremen who have won high marks in the Intermediate examination. The Combustion Engineering Course is at a high educational level, and is intended for engineers and chemists and others concerned with the testing of combustion equipment, but it is also open to students with a first-class pass in the Final Grade Boilerhouse Practice. The amount of coal burnt in colliery boilers is being reduced each year but it is still high (6.6 million tons being consumed in 1958), and substantial economies can be achieved by efficient firing. A recent Order under the Clean Air Act makes it clear that mechanically-fired coal-burning furnaces are permitted in smoke control areas but only if efficiently fired. Thus high standards in the boilerhouse are ever more widely needed.

NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE

The National Institute for Research in Nuclear Science announced recently that contracts amounting to a total cost of over £430,000 have been placed for the manufacture of the magnet coils required to energise the 7,000-ton electromagnet of the 7,000 million electron-volt Proton Synchrotron. This machine, which has been named NIMROD, is being built for the Institute by the United Kingdom Atomic Energy Authority at the Rutherford High Energy Laboratory, Harwell. Contracts have been awarded to British Copper Refiners Limited, Prescot, Lancs, for the supply of over 300-tons of refined copper, (from which the coils are to be made) in the form of cast billets ; to James Booth and Co. Ltd., Birmingham, for extrusion of the cast copper into hollow rectangular bars ; and to Metropolitan-Vickers Electrical Co. Ltd., of Manchester, for the manufacture of the finished coils from the extruded bars. The Institute have also awarded a substantial contract to Marston Excelsior Limited, Wolverhampton, for the development and supply of the reinforced plastic vacuum chamber in which the protons are accelerated. This chamber is one of the largest plastic structures ever made. Nimrod is a large machine for accelerating protons (the nuclei of hydrogen atoms) to high energies (7,000 MeV) for the purpose of carrying out fundamental studies of sub-atomic particles and the forces which hold atomic nuclei together. The electromagnet for which the coils are required is designed so as to guide and focus the accelerating protons into a circular path. The vacuum chamber is required to enclose this circular path in order that the rotating beam of protons will not be dispersed to a damaging extent by collision with air molecules. After over a million revolutions the protons are ejected with a speed approaching that of light, and may be used for a great variety of experiments on the physics of elementary particles.

INSTITUTION OF MECHANICAL ENGINEERS

The Council of the Institution of Mechanical Engineers has, during the past few years, acquired the head leases of property adjoining its headquarters at Birdcage Walk, Westminster. Plans for developing this property have now been prepared, the additional space providing much-needed additional accommodation for the staff, and amenities for members of the Institution. The new council room, complete with projection equipment, may also be used as a meeting hall to seat an audience of 150. Plans are also in hand to enlarge the existing lower meeting hall to seat 130 people under improved conditions, and to improve the kitchen accommodation and equipment to enable better service of refreshments to be made. The council is anxious to ensure that the extended headquarters shall meet the needs of members as completely as possible, and will, therefore, welcome suggestions for particular amenities to be included in the overall planning. Members may well be in a position to suggest certain desirable improvements which, if considered at this stage, could readily be incorporated in the plans. Members who wish to put forward suggestions are asked to submit them, in writing, to the secretary of the Institution without delay. It is hoped that the extended headquarters may be in use during the 1960-61 session. The Institution has also directed attention to the change in the day on which ordinary meetings will be held in the forthcoming session. The meeting day is to be Wednesday (instead of Friday) at 6 p.m. The opening meeting of the new session is on Wednesday, October 14th, at 6 p.m., when Mr. H. Desmond Carter will deliver his presidential address entitled " The Engineer, Life and Diesel Engines."

THE COMBUSTION ENGINEERING ASSOCIATION

The Combustion Engineering Association conference on November 3rd and 4th, 1959, at the Royal Hotel, Scarborough, will discuss the application of automatic control of the smaller industrial boiler plants using solid fuel. Mr. S. P. Chambers, C.B., C.I.E., a deputy-chairman of I.C.I. Limited, and president of the Association, will be in the chair, and opening addresses will be given by Mr. R. H. E. Thomas, the National Coal Board member for marketing and supplies, and by Mr. B. E. A. Vigers, assistant managing director of Laporte Industries Limited. Four technical sessions to discuss " Fuel and Ash Handling," " Combustion and Mechanical Firing," " The Principles of Automatic Combustion Control," and " The Application of Automatic Control," will be followed by group and open discussions, and a final session at which an assessment of the economics of installing automatic handling and control equipment will be made. At a dinner on November 4th, Mr. J. Latham, C.B.E., deputy-chairman of the National Coal Board, will be the principal guest and speaker. The main purposes of the conference are to show that the automatic solid-fuel-fired boiler plant is technically feasible, and to examine its justification on economic grounds. The conference will consider the savings in fuel and labour costs which can be made, and the effect on productivity of having a more reliable and effective steam supply. The conference will be open to the public. Full details can be obtained from the Combustion Engineering Association, 70, Jermyn Street, London, S.W.1.

STRONGER LINK BETWEEN INDUSTRY AND FURTHER EDUCATION

A closer and more efficient tie-up between industry and commerce and further education establishments will result from a circular issued to local education authorities recently by Mr. Geoffrey Lloyd, Minister of Education, which gives guidance on the make-up and functions of governing bodies of all these establishments. A regulation made last March provided that all major establishments should have governing bodies which included substantial representation of industrial, commercial and other appropriate interests. In the case of establishments providing a considerable number of advanced courses, representatives of universities and professional bodies should also be included. In the Minister's view, the governing body of a technical or commercial college should consist largely of people—whether members of the authority or not—who have current experience of problems of industry and commerce relevant to the work of the establishment. He believes that the vigorous participation of the representatives of industry and commerce in the life of these establishments is a matter of the utmost importance. If it is to be fruitful, governing bodies must be given an active and responsible part to play in every respect.

Choice of Coal Preparation Systems for Pulverised-Fuel-Firing

By JÁNOS M. BEER, Dipl.Ing., M.Inst.F*

THE term " coal preparation " is used in these notes to mean the operations that occur in a boiler house between the raw-coal bunkers and the pulverised-coal burners on the furnace. This includes both grinding and drying of the coal, the preparation of the primary mixture and its transport to the burners. The relationship between the coal-preparation and the method of firing is very close, so much so, that the coal preparation is often regarded as an integral part of the firing system. The wide variety of coal-preparation systems used reflects the complexity of the design problem involved. The main features of the boiler plant, e.g., unit performance, type of coal burned, method of firing, availability, thermal efficiency, cost of installation, of operation and of maintenance, etc., all have important roles in the choice of the most appropriate coal-preparation system. The successful technique is to select and satisfy the most important factors in any given case. It follows, therefore, that no hard and fast rules can be given for the choice of such a system in general. The purpose of this article is to draw attention to the possibilities of improving efficiency by the correct choice of system, and also to determine the possible magnitude of any such improvements.

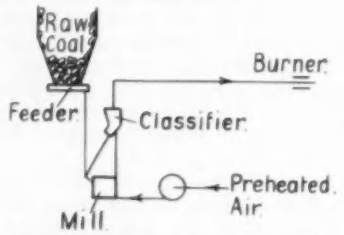

Fig. 1. Direct-system with the pulveriser mill under pressure.

Classification of coal preparation systems

Existing coal preparation systems can be classed broadly as " direct " or " indirect," with subdivisions as given below. The basis of this classification is the path followed by the drying gases, since this may affect the thermal efficiency of the whole plant. The drying gases may be preheated-air, the products of combustion, or a mixture of both. If the ground coal is carried from the mill directly to the burners so that the drying gases are present in the primary mixture, the system is known as " direct," and if before being transported to the burners the ground coal is separated from the drying gases, the system is known as " indirect." The " direct " systems are straightforward, but the basis for the subdivisions for the " indirect " systems requires further amplification. In these systems the drying gases can be vented to atmosphere after separation from the coal, this being known as " open circuit," or in what is termed " closed circuit," it may be found necessary or even desirable to return the drying gases to the combustion chamber. This is usually effected via an effluent burner. Finally, in both " open " and " closed " circuits the " indirect " system can be used either with or without storage.

The complete classification system, put forward for the purpose of discussion in this article, is therefore as follows—the different systems being shown diagrammatically in Figs. 1 to 7, viz.:—

(A) Direct Systems:
- With the pulverising mill under pressure — Fig. 1
- With the pulverising mill under suction .. — „ 2
- With " self ventilating " mills .. .. — „ 3

(B) Indirect Systems:

Open Circuit
- With storage (bin and feeder) .. .. — „ 4
- Without storage

Closed Circuit
- With storage (bin and feeder) .. — „ 5
- Without storage .. .. .. — „ 6

Dual Circuit .. .. — „ 7

The three direct systems given in the classification are in fact the most widely used at present. They are relatively simple from both the constructional and operational points of view, the installation costs thus being low, and the availability high compared with other, more involved systems.

Pulveriser mill under pressure (Fig. 1)

For drying purposes, the medium used is air, which is delivered by a mill-fan from an air-preheater to the mill. Being located prior to the mill, the fan is therefore subject to practically no heavy wear. This is advantageous from considerations of availability and maintenance costs. A possible disadvantage is that very wet coals may have to be pre-dried, since the temperature of the preheated air entering the mill is limited partly by the usual air-preheater and fan construction, and partly by safety precautions against ignition of the coal within the system. The rate of flow of the preheated air (the latter being not only the drying medium but also primary-air in the burner) is controlled to follow the variation of load of

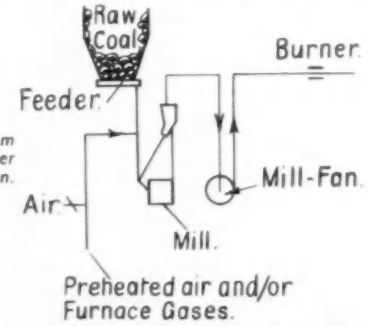

Fig. 2. Direct-system with the pulveriser mill under suction.

*Department of Fuel Technology and Chemical Engineering, University of Sheffield.

the mill—the fuel/air ratio in the primary mixture thus being kept at a suitable ratio at all load conditions. (It is inevitable, however, that the fuel/air ratio should decrease slightly as load decreases, because of the constant heat losses of the mill).

Pulveriser mill under suction (Fig. 2)

In this system, the drying medium is generally preheated air, but if necessary, for wet coals, the temperature of the drying air can be increased by the addition of hot air extracted from the combustion chamber or from the boiler outlet flues. An advantage of the use of combustion gases in the primary mixture is that a higher proportion of the combustion air can be supplied as secondary air and preheated to a higher temperature. The extraction of the gases from the combustion chamber is made possible by the mill fan placed between the mill and the burner, thus keeping the mill under suction, and also because the fan itself is protected against excessive gas temperature. The disadvantage is, of course, that with this arrangement, the fan is subject to excessive wear owing to the erosion effect of the pulverised coal. In order to increase availability, usually a heavier construction is required, with a consequent loss in fan efficiency. Installation costs will also be higher and, furthermore, maintenance costs will possibly increase, particularly if the coals to be ground have a high ash content, or if they contain hard substances such as pyrites. The control of the rate of flow of the drying medium follows the load variation of the mill in this system as well.

Self-ventilating mills (Fig. 3)

While the above-mentioned two systems are probably the most widely-used in this country, systems incorporating self-ventilating mills were developed on the Continent mainly for the use with soft brown coals, and more recently their use has spread to other brown coal and

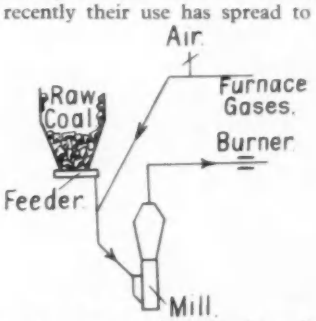

Fig. 3. Direct system with a self-ventilating mill.

peat areas—particularly Australia[1] and Ireland.[2] The basis of the system is a beater-type mill in which the fan effect of the rotor is improved by appropriate design. Despite the fact that these mills are neither highly efficient fans nor very good grinding machines, their use attracts both the designer and the operator because of the simplicity of their construction, and the high availability of the coal preparation arrangement involved. Gas ducting and p.f. pipe-lines require careful design to reduce flow resistance to a minimum because of the low fan performance available.[3] This also calls for the use of a simple classifier of low flow-resistance in the circuit. It is generally possible to use such classifiers for easily-ignited brown coals, as they do not require great fineness in grinding. Also, as these coals are mainly soft they do not cause excessive wear on the beaters of the mill. (If the ash content of the coal is high, the amount of wear on the beaters, that move with a high circumferential velocity of about 180-ft./sec., can be excessive.)

Self-ventilating systems generally operate with a constant rate of gas-flow irrespective of the variation of the load. Thus, instead of the rate of gas-flow, the inlet temperature of the drying gas is controlled by the addition of preheated air or of cold air to the hot combustion products; this can be effected easily since the mill is working under suction. The use of such a system is, of course, limited to coals the combustion of which is not greatly affected by the fuel/air ratio of the primary mixture, as are, for example, high-volatile brown coals. The use of self-ventilating mills can be extended to the more "reactive" black coals in a system in which the mill is working under slight pressure and, generally with preheated-air as dryer medium. In this case, the self-ventilating effect on the mill is assisted by a supply from a forced-draught fan of the boiler. Thus, this tends to overcome the increased flow resistances caused by a more involved classifier and pipe-lines, without the need for an additional mill fan.

Limitation of use

In spite of the wide application of the "direct" systems, their use is limited in so far as the gases used in the circuit operate both as drying gases and as primary combustion gases; these must, therefore, satisfy two independant conditions:—one for drying and one for combustion. The condition for drying can be expressed as:—

$$A_d \geq \frac{M}{k} \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad 1$$

where $$M = \frac{m_1 - m_2}{1 - m_2}$$

Here A_d — is the flow rate of dryer gas (n cu. ft./lb. coal)

M — is the moisture to be evaporated (lb. H_2O/lb. coal)

m_1 — is the moisture content of the raw coal (lb./lb.)

m_2 — is the moisture content of the "ready to burn" p.f. (lb./lb.).

(Usually it is the surface moisture of the coal that is to be dried off in order to obtain a reasonable grindability) and k is a quantity given by

$$k = \frac{Cp \,.\, \Delta\Theta}{Q_d}$$

Where C_p — is the specific heat of the drying gas (B.T.U./cu. ft. deg. F.)

$\Delta\Theta$ — is the temperature drop of the drying gas in the circuit (deg. F.)

and Q_d — is the heat consumed in the circuit for the evaporation of 1 lb. moisture (B.T.U./lb. H_2O.)

(The value of Q_d varies in actual coal preparation plants between 1,350 and 1,800 B.T.U./lb. H_2O.)

The gas-flow in the circuit of a direct system must also satisfy the condition for the ratio of primary air. This may be calculated from the rule of thumb generally adopted, which assumes that the primary air must not exceed the quantity required to consume all the volatiles present.

Hence $$A_p = A_{th} \,.\, n \,.\, V_m \qquad \ldots \quad \ldots \quad 2$$

where A_p = rate of primary air (n cu. ft./lb. coal)
A_{th} = rate of theoretical combustion air (n cu. ft./lb. coal)
n = excess air factor $\left(n = \frac{CO_2 \text{ max. dry}}{CO_2 \text{ actual dry}} \right)$
V_m = rate of volatile matter lb./lb. D.A.F.)
Combining equations (1) and (2) we have

$$M \leq KA_{th} \cdot n \cdot V_m \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad 3$$

If this inequality is not satisfied, for example, when firing high-rank coal with high moisture and ash content, either the air rate is too low to dry the coal as required, or else the primary mixture becomes too lean, which then upsets the combustion.

Indirect systems

One of the earliest systems to be used in commercial practice was the indirect system in open circuit. (Bin and feeder system.) At this stage of the development central coal preparation plants were favoured—i.e., the pulverised fuel for a whole boiler house containing several boilers was prepared in a separate coal preparation plant and this could only be built in open circuit. As reliability of the grinding process improved, and boiler unit performance increased, the idea of central coal preparation was abandoned and individual coal preparation was developed mainly in the form of the direct system. Indirect systems, however, have returned to prominence again in the form of individual plants, since they have been found in certain instances to be the only means of solving the coal preparation problem for special firing systems such as slagging furnaces, cyclone firing, etc., and proved to be very helpful in obtaining higher thermal efficiencies when burning high moisture coals.[1]

Open circuit

The essence of the open circuit is to dry the coal with hot combustion gases and then to vent the dryer gases and the moisture evaporated to the atmospheres. Open circuits need therefore highly-efficient precipitators to prevent the coal dust from passing to the atmosphere with the dryer gases.

Fuel storage (Fig. 4)

It is p.f. storage bunkers and dust feeders (bin and feeder) that open circuit systems are usually designed with. In the central coal preparation plants the storage was the most important feature of the system. Although the main attractions of an open circuit coal preparation today are different, the storage might still provide advantages, e.g., when using air-swept ball mills for grinding in the circuit. These mills are somewhat cumbersome from the point of view of control, and thus they are more suitable for uniform loading, so that any fluctuations should be taken up by storage bunkers. Also, in the case of an emergency shut-down of the boiler, the mill—containing an appreciable amount of ground coal—can be discharged into the storage bunker thus minimising explosion risks, particularly when firing highly-reactive coals.

Fig. 4A shows an application of the open circuit with storage to a dry-ash p.f. firing.[4, 5] As the coal burnt in this firing system is of high moisture-content, the designers raised considerably the thermal efficiency of the whole plant. The total gas-flow leaving the preheater and economiser enters the coal-preparation system and leaves through the i.d. fan into the atmosphere at about 190 deg. C.—thus considerably reducing the waste-gas heat losses.

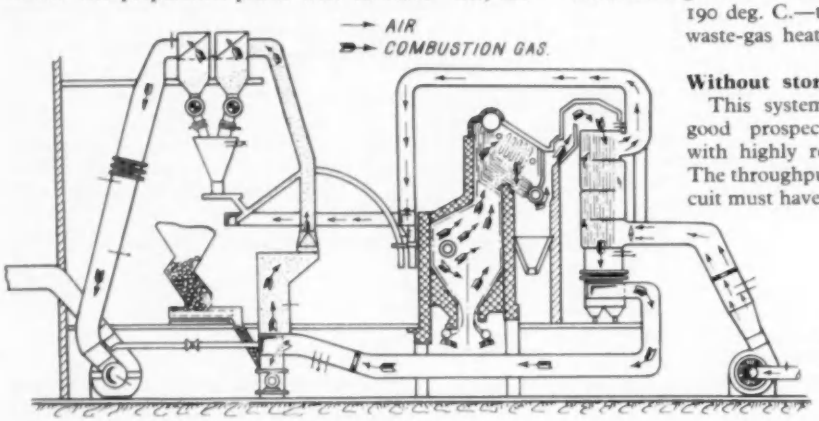

Fig. 4a. Applied open-circuit system with storage. (After P. N. Kendys. World Power Conference, 1956. Report No. 24862/17.)

Without storage

This system, hitherto seldom used, has good prospects, especially in connection with highly reactive and wet brown coals. The throughput of the mill used in such a circuit must have a quicker response to the control of the raw-coal feeder, otherwise the control of the system becomes sluggish. As shown later in these notes, the open circuit system without storage can be used in a so-called "dual system,"[6] thus utilising the advantages of the open circuit without most of its technological difficulties.

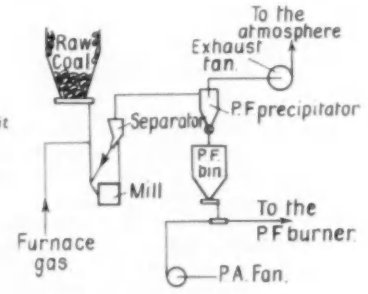

Fig. 4. Open-circuit with storage.

Closed circuit

When an indirect system is to be used in the form of an individual plant it is advantageous to introduce the effluent gases leaving the precipitator, into the boiler, thus forming a closed circuit, mainly because of the lessened demand on the precipitation.

On the other hand, a new problem arises by the provision of an "effluent burner" through which the

gases and some pulverised fuel pass into the combustion chamber, and by its proper attachment to the furnace. It is partly the inconvenient gas composition, high ratio of inert gases, and partly the very low p.f. concentration that makes it difficult to find a solution for these effluent burners. This then is often the reason for unpleasant deposits both in the combustion chamber and superheater. Also, when the effluent burner operates intermittently—as it generally does with p.f. storage systems—this then may introduce an additional difficulty with the superheat control, due to the fluctuation of gas mass flow across the superheater.

With storage (bin and feeder) (Fig. 5)

This scheme is probably the most widely-used scheme for indirect systems, this being, for example, the coal preparation system for horizontal cyclone firing, where storage makes an even feed-rate to the cyclone possible.

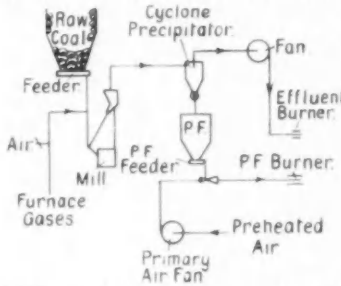

Fig. 5. Closed-circuit with storage.

This would have been very difficult to achieve without efficient storage because of the system of valves that is needed in the path of the broken coal as it passes from a low-pressure grinding system into a high-pressure primary air stream.

Without storage (Fig. 6)

In view of the increased risk of explosion when burning highly reactive brown coals, designers seek a means of sidestepping the storage of such a fuel. The coal preparation developed for vertical cyclone firing for brown coals

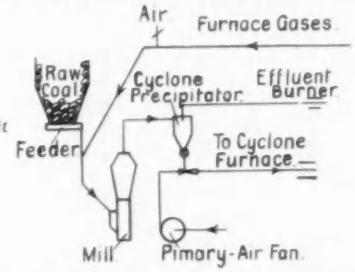

Fig. 6. Closed-circuit without storage.

presents a good example of that class.[7] As high temperatures had to be kept in the cyclone, an indirect system was chosen in order to keep inert gases out of the cyclone combustor. Storage, which was not preferable because of the brown coal burned, could be here dispensed with because of the relatively lower primary-air velocities, i.e., pressures used in vertical cyclone firing.

Criteria of choice of circuit

If the criterion expressed by equation (3) or the technology suggests that an indirect system is to be preferred to a direct system, there is then a choice to be made between an open or closed circuit. Apart from considerations concerning the technology of grinding or that of firing, there is an important difference between the open and closed circuits affecting the waste-heat losses of the whole plant. The problem arises from the fact that drying gases can be cooled down during coal preparation, to a reading far below the outlet gas temperature of the boiler. This is because the metal parts of the coal preparation equipment, that are liable to corrosion due to a low gas temperature, are cheap to replace as compared to the expensive heating surfaces of the boiler (economisers, preheaters). Thus, the waste-gas losses of the whole boiler unit can be decreased in an open circuit. This gain increases obviously with the drying gas-moisture flow rate in the drying system especially when using wet coals. In a closed circuit this advantage is not made use of because the dryer gases are introduced again into the boiler and leave finally with the chimney gases at a higher temperature.

Regarding the thermal efficiency of the whole plant, the following factors may be taken into account for the comparison of an open and a closed circuit.

(1) In an open circuit, a more efficient form of precipitation must be used than is necessary in the closed circuit, so that the fan capacity must be increased because of the higher flow resistance of such a precipitator (mechanical). This increase in fan capacity may be given by:—

$$\frac{V_g}{Q} \cdot \frac{\Delta p}{A \cdot \eta_f}$$

where Δp — is the pressure drop across the precipitator lb./sq. ft.
η_f — is the fan efficiency
V_g — is the volume throughput of dryer gas plus vapour in the coal preparation circuit at drying temperature cu. ft./lb. coal
Q — is the nett calorific value of the coal
A — is the mechanical equivalent of heat.

(2) In open circuit there will be some "loss of fines": that in the closed circuit is reclaimed through the effluent burner. This will be determined as

F lb./lb. raw coal

(3) In open circuit the dryer gas and vapour is vented to atmosphere at about 160 deg. F. In closed circuit these gases emerge from the boiler to be vented from the stack at a higher temperature, usually about 360 deg. F. If the temperature difference of vented gases in open and closed circuit is ΔT, the heat gained by an open circuit compared with the closed will be

$$\frac{V_g}{Q} Cp \cdot \Delta T$$

The criterion of the choice between the open and the closed circuit can, therefore, be expressed, that if:

$$\frac{V_g}{Q} \frac{\Delta p}{A \eta_f} + F < Cp \, \Delta T \frac{V_g}{Q} \quad .. \quad .. \quad .. \quad (4/a)$$

the open circuit is desirable; and if the inequality is reversed, the closed circuit is desirable. In terms of $\frac{V_g}{Q}$ which is the critical quantity, equation (4/a) can be written

$$\frac{V_g}{Q} > \frac{F}{Cp \, \Delta T - \frac{\Delta p}{A \cdot \eta_f}} \quad .. \quad .. \quad (4/b)$$

for the open circuit criterion. What this means in physical or engineering terms is that as the volume of dryer gas and moisture increases, a point is reached where the gains in reducing waste gas heat losses from the boiler are greater than the losses of the open circuit; i.e., the losses due to fines vented into the atmosphere, plus the greater self consumption due to the greater flow resistance of high-efficiency precipitators used in open circuits.

In a typical example, detailed quantities were found to have the following values:

F = 0.015 lb./lb. (precipitation efficiency = 98.5 per cent.)
C_p = 0.02 B.T.U./cu. ft./deg. F.
ΔT = 360 − 160 = 200 deg. F.
Δp = 200 mm. W.G. = 40.96 lb./sq. ft.
η_f = 0.8.

Substituting in the inequality (4/b): $\frac{Vg}{Q} > 3{\cdot}85.10^{-3}$

and thus $V_g > 3{\cdot}85.10^{-3} . Q$

Therefore if Q is, for example, 6,300 B.T.U./lb., the minimum value of V_g above which an open circuit will be more efficient is $6{,}300 \times 3{\cdot}85.10^{-3} = 24$ cu. ft./lb. coal.

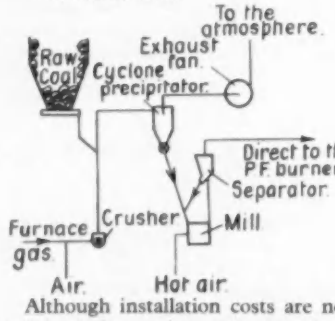

Fig. 7. Duo-circuit.

Although installation costs are not considered in this article, it is worth mentioning that, when open circuit coal-preparation has been chosen for a boiler plant (because of consideration discussed above), saving in installation costs is also likely because of the decrease of heating surfaces with decreasing gas-flow rate through the boiler. Fig. 8 depicts a characteristic example of this. The two boilers represented were designed for the same high-moisture coal, and have the same performance.[8] The coal preparation equipment (shown on left) is a direct system, and that of the boiler on the right is an indirect system in open circuit. The comparison shows clearly that the predrying of the coal in open circuit improves, in this case, not only the thermal efficiency, but makes possible a considerable reduction in boiler size and therefore lessens the installation cost of the whole plant.

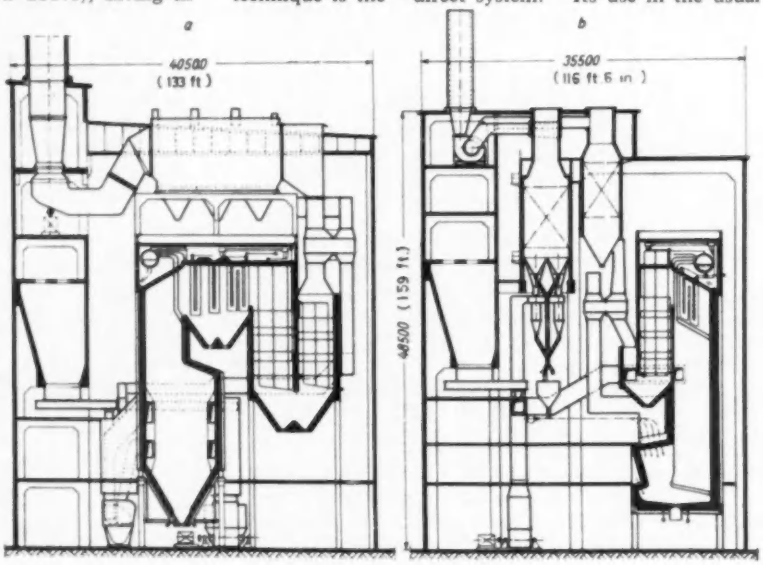

Fig. 8. Comparisons of boiler volumes for (a) the direct system and (b) the open circuit for a high moisture content coal. (After H. Lenkewitz. V.G.B. H.51 (1957), p.386.)

Dual circuit (Fig. 7)

In spite of the advantages mentioned, open circuit coal preparation schemes are relatively few and far between and direct systems are often preferred, though the coal quality would justify an open circuit design. The reason for this is that open circuits are generally more complicated compared with direct systems, and particularly because the problem of the p.f. precipitation may be an acute one.

To overcome these difficulties, a special coal preparation scheme, the dual circuit, can be incorporated. This consists of two circuits which operate in series. The raw coal is fed into the first (an open circuit) in which it is crushed to about $\frac{1}{4}$ in. size, and dried by hot combustion gases extracted from the boiler. The gases are then vented into the atmosphere through a precipitator and then the pre-dried crushed coal passes directly (without storage) into the grinding mill. The mill operates in the second circuit, and may work with pre-heated air as drying medium. This circuit is actually the same as that in a direct system, with the exceptions that the coal is crushed and pre-dried, and also that the coal feeder is situated in the open circuit as a raw coal feeder, with no other feeder in the system. The dual circuit has the advantage that the coal to be precipitated is coarse-crushed coal which makes the solution of the precipitation problem much easier. It can be used for wet coals either to improve a direct system, or to simplify an indirect.

Conclusions

In these notes coal preparation for pulverised-fuel-fired boilers is discussed from the point of view of technological requirements and with special regard to the better use of thermodynamic possibilities of the whole boiler plant.

The simplest and most widely-used coal preparation technique is the "direct system." Its use in the usual

type of dry ash firing is limited only when the coal burnt would not satisfy the criterion expressed in equation (3). In this, a limit of the moisture to be dried off is given as a function of the rate of combustion air and the volatile matter of the coal:

$$M \leq k \cdot A_{th} \cdot n \cdot V_m$$

Also, some other requirements, partly concerning the firing system and partly concerning the grinding process, may affect the design of the coal preparation system and may lead to the abandonment of the simple direct system in favour of an indirect system in either open or closed circuit.

A further criterion expressed in equation (4b) gives the critical value of the rate of drying gas above which an open circuit is more efficient from the point of view of thermal efficiency than a closed circuit or a direct system.

$$V_c \geq Q \frac{F}{C_f \Delta T - \frac{\Delta p}{A \cdot \eta_f}}$$

In Fig. 8, it is shown that when an open circuit is justified from the thermodynamic point of view, it also usually tends to reduce installation costs, because of the decreased heating surfaces of the boiler.

Finally, a so-called dual circuit is suggested to overcome the main technical difficulties associated with an open circuit, i.e., to increase efficiency in the coal precipitation. The dual circuit helps to extend the use of the open circuit in the coal preparation system and also allows for an increase in the thermal efficiency of boiler plants.

In conclusion, the author acknowledges his indebtedness to Professor M. W. Thring for his advice and encouragement in the preparation of this article, to Mr. R. H. Essenhigh for his helpful assistance and guidance, and to the Electricity Supply Research Council for permission to publish the article.

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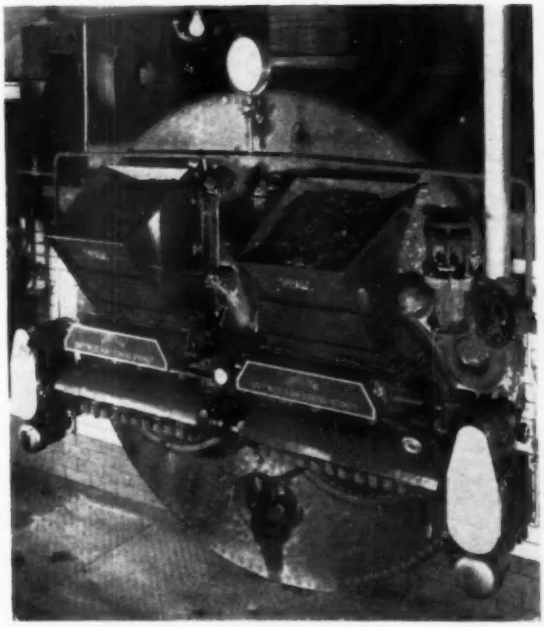
Unit Wide-Ram Coking Stoker

AFTER extensive research and development, backed by nearly a century of experience, James Proctor Limited, Hamerton Street, Burnley, have introduced the new Proctor unit wide-ram coking-stoker which has been designed specifically to comply with all the provisions of the Clean Air Act. Proctors believe it to be the most advanced machine of this type, suitable for all shell-type and small water-tube boilers.



Front view of a Lancashire boiler fitted with Proctor Unit Wide Ram Coking Stoker.

This new coking stoker is applied as a separate unit to each furnace flue, with hydraulic infinitely variable speed control of grate and feeding mechanism—an arrangement which enables the user to deal efficiently with the problem of variable boiler loads, and also provides for maximum "turn down." The machine embodies all established features of the coking principles of combustion—that is, the release of volatile matter in the fuel takes place at the front of the grate and must pass over the incandescent coke-bed covering the rest of the grate, all hydrocarbons being thoroughly consumed. The continuous action of the self-cleaning fire-bars automatically removes the ash to an ashpit at the rear of the furnace, from where it can be removed periodically without interfering with the operation of the stoker or disturbing the fire-bed. The ram is of the maximum width obtainable in a circular furnace flue, and it has patented features which have resulted in obtaining complete coverage of the grate. The ram, with variable stroke, is driven by an eccentric fitted to the driving unit, a feature which results in a very positive action. A safety device is incorporated to protect the mechanism, and the ram itself can be isolated, thus leaving the fire bars "working," by means of a hand-operated dog clutch. The bottom plate of the ram box which is subjected to most wear, is made as a separate part and is easily and cheaply renewed.

For lighting-up, or for emergency, hand-firing is provided, giving access to the full width of the grate, while the fire-door itself can be opened without having to "stop" the stoker or disconnecting any mechanism. Carried on the fire-door is the top coking plate, which is cast in renewable sections and designed with ample cooling surface. Here again, replacement is extremely simple, the fire door being swung out and the plates dropped into position. This operation can be carried out while the stoker is in operation.

The bottom coking plate, cast in either S.G. iron or Carbofrax material, is arranged in renewable sections and supported on a cast-iron bearer carried from the stoker front-plate. The makers claim that everything possible has been done in order to provide a coking plate which will withstand burning,

and by careful choice of materials and by providing the casting with the maximum cooling surface, this has been achieved. The self-cleaning fire-grate is formed by plain longitudinal fire-bars of the well-known Proctor design, thin and deep in section, and giving the largest possible ratio of cooling surface to grate area. The front of each bar is carried on a roller, thus reducing friction losses at this point, while the rear is supported on a steam-cooled bridge. The fire-bars are operated by chilled cams threaded on a hexagon shaft, and are arranged to take the entire grate backwards at one movement, and then return alternate sections, giving a powerful self-cleaning action. The clinkers are gradually worked off the rear of the grate into the ashpit, from which it is periodically removed by the attendant, with a special long-handled shovel supplied with the stoker. Cooling is supplemented by the circulation of a small amount of steam through the back bearer, which keeps the bar-ends cool, and is then exhausted through jet pipes arranged below the bars at the maximum temperature areas and also to prevent the adhesion of clinker. The steam is not used for producing draught, and the amount used is negligible.

The Proctor self-cleaning fire-bar has, it is claimed, been proved, over many years, to give an exceptionally long life and freedom from excessive roddlings.

The driving unit applied to *each* unit machine comprises a 0.75 h.p. totally-enclosed fan—cooled standard motor, with an output speed of 1,410 r.p.m. driving a Carter hydraulic infinitely-variable speed gear, the output speed being variable between 1,410 and 50 r.p.m. Speed control is by small hand-wheel incorporating a speed indicator. These units are of simple design and robust construction, and housed in a dust-proof fan-cooled casing. The output shaft of the gear is coupled by a totally-enclosed Renold chain drive to a single-reduction worm gear unit. The gear is totally-enclosed in a strong cast-iron casing, the output shaft carrying the ram eccentric and the outer-half of a dog clutch. The gear is coupled through this clutch to the cam shaft of the stoker.

It is claimed that this new Proctor coking stoker will burn efficiently and without excessive smoke, a very wide range of fuels from rough slack up to doubles. The machine is designed to allow for extremely robust and simple construction, and incorporating many new features. Furthermore, the makers claim that maintenance costs are likely to be very low, and the minimum of attention necessary.

Effluent Drainage System at Battersea Power Station

The reconstruction of drainage systems at Battersea power station has involved the use of about 1,000-ft. of large dia. reinforced epoxide pipes, making it the largest installation of this type of pipework in Britain. The epoxide pipe has replaced ceramic piping in a system which carries effluent from flue-gas washing plant, located in two of the four chimneys, to a treatment unit from which the effluent is eventually discharged into the Thames. The flue-gas washing plants, with removal efficiencies of the order of 85-90 per cent., ensure that the chimneys do not emit smoke, and only a minimum of sulphur passes into the atmosphere. The effluent from these plants, after discharging the larger ash particles into settling tanks at the base of each chimney, contains a percentage of sulphuric acid, and owing to its remaining ash content is highly abrasive.

(Left). A 20-ft. length of large-diameter elliptical pipe made from epoxide resin, being lowered into a trench at Battersea power station.

(Right). Making a joint between an 18-in. dia. epoxide resin pipe, and the end of an existing ceramic pipe embedded in concrete.

The present contract has involved the replacement of the drainage system from the S.W. chimney, and the renewal of certain lengths which had become affected or damaged in the system from the N.W. chimney. All the new pipes, manhole covers, and fittings were made from Bakelite epoxide resin, reinforced with glass fibre and Terylene, the latter giving added abrasion resistance to the inner surface of the pipes. The pipework was manufactured and installed by Mendip (Chemical Engineering) Limited. Two diameters of pipe are used in the installation, viz., 18-in. and 15-in., some being of elliptical cross-section to allow for fitting into narrow positions. In the S.W. chimney, the down pipes from the washing-plant are encased in concrete along part of their length, and the original ceramic pipes have, therefore, not been disturbed. At the base of the chimney, the ceramic pipe is connected to the first length of epoxide pipe by a normal joint.

The epoxide pipes have been produced in 10-ft. sections, each section weighing about 90-lb. and capable of being easily handled by one man. As most of the pipework is installed in a concrete trench, it was found to be easier to join two lengths on site before lowering the pipe into the trench. All joints between sections of epoxide pipe are of the spigot and socket type, bonded with an epoxide glass fibre composition. As the installation was carried out during the winter, often in temperatures below freezing point, the curing of the epoxide resin at the joints presented some difficulty. A method was devised of using blanket-type electric heaters over the outside of the joint, and large oil-burning heaters, in conjunction with fans, blew hot-air through the pipes. Expansion and contraction stresses arising from changes in the ambient temperature can be accommodated in the pipe itself, and no special provisions have to be made for changes in length. Where the pipe has not been encased in concrete, it is mounted on rubber-capped stools. In addition to being light, and, therefore, easy to install, the epoxide pipe can be repaired without removing it from the trench, by using a patching technique; and once installed, the pipes are not prone to fracture through vibration or shock loads. Also, although in some parts river water frequently laps the outside of the pipes, no special measures to prevent corrosion have been deemed necessary.

Winfrith Heath Research Establishment

Winfrith Heath is the youngest establishment of the Atomic Energy Authority and will be the second major establishment of the Research Group. It will be mainly concerned with basic research and early development work on all aspects of atomic energy and in particular to provide new ideas and basic design data for application to power generation

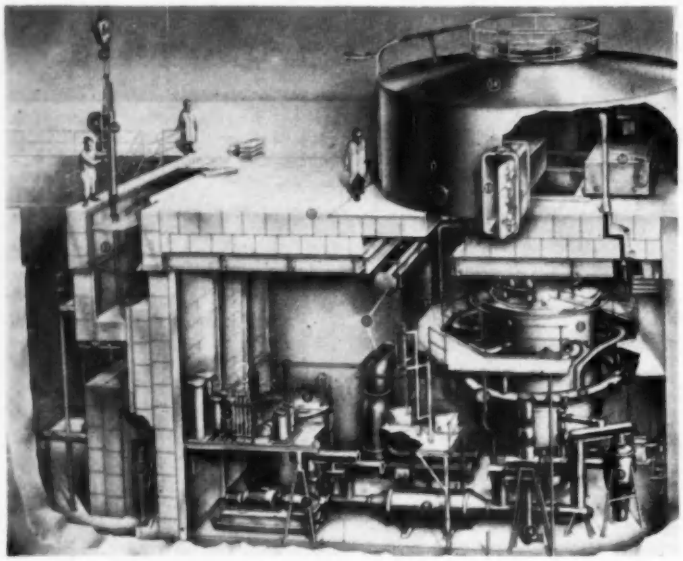
WE recently had an opportunity of visiting the new Winfrith Heath Research Establishment of the United Kingdom Atomic Energy Authority, which is in course of construction on a 700-acre site near the Dorset coast; about five miles north of West Lulworth and one mile west of Wool station. The area that is being developed initially measures approximately $1\frac{3}{4}$ miles by 1 mile, and within it there are some six possible sites for reactors arranged around a central group of buildings which will include two zero-energy halls, reactor group offices, a general services building, a central technical building, and an apprentices' school. Other major buildings still to be erected are the health physics building, a medical centre, space for the control and instrumentation work, a building to house a Mercury digital computer and offices for the "Dragon" project.

One of the main purposes of the Authority's research programme was to realise the full potentialities of the gas-cooled graphite-moderated reactor. Among efforts being made to reduce the capital costs, and to improve the efficiency of this type, the most promising appear to be those being directed towards the development of a high-temperature gas-cooled reactor which could be used with high-temperature high-efficiency steam or gas turbines. In fact, the possibilities are considered to be so promising, that an agreement was signed in March last for a joint project known as "Dragon" in which six European countries (Belgium, France, Italy, Luxembourg, the Netherlands and Western Germany) are collaborating, through Euratom, with Austria, Denmark, Norway, Sweden, Switzerland and the United Kingdom. This joint project covers a five-year period, during which the total expenditure may amount to £13.6 million. The countries concerned have agreed that £10 million of this should be shared between them on an agreed basis, while any costs in excess of this amount up to £3.6 million would be paid by the United Kingdom alone, and to whom any reactor experiment and other installation or equipment built or acquired in the United Kingdom would belong at the end of the five-year period.

It has a two-fold object:—first, to carry out a research and development programme on high-temperature gas-cooled reactor systems and secondly to design, construct and operate a reactor experiment based on the results of this work. The first of these objectives is already in hand, and the work has now reached an advanced stage. It comprises the zero-energy reactor "Zenith" (part of Britain's own programme) which will be used for checking the reactor physics design calculations for the high-temperature experiment; and secondly, the exponential experiment to assess the reactor core arrangements for "Zenith." Thus, the principal task is to initiate basic research and development work on all aspects of atomic energy, and in particular provide new ideas and basic design data for application to power generation. "Zenith" (the main contractor for the design and supply of which is The General Electric Co. Ltd., through their Atomic Energy Division at Erith) is now being subjected to commissioning tests, and the reactor is expected to go critical later this year. The team of physicists, mathematicians and engineers now engaged on these problems, at Harwell, are in process of moving to Winfrith, where they are being joined by the European scientists and engineers who have been seconded to the "Dragon" project. Harwell, however, will still be concerned with research on the chemical, metallurgical and nuclear physics side of the experiments.

"Zenith," as mentioned above, is a zero-energy reactor designed to operate under temperature conditions similar to those expected in a high-temperature power reactor. It enables power reactor design studies to be made at high temperatures, and avoids the limitations involved in attempts to

Aerial view of Winfrith site taken earlier this year, showing the Zenith building in the foreground, the workshops in the middle distance and the apprentices' school in the background.



Cut-away diagram of Zenith reactor.

KEY: (1) Reactor vessel. (2) Control rod mechanism. (3) Nitrogen supply to reflector. (4) Nitrogen supply to heater. (5) Nitrogen filter. (6) Heat exchanger. (7) Nitrogen circulator. (8) Nitrogen purification plant. (9) Nitrogen gas holder. (10) Waste-heat ventilation system. (11) Fuel element storage. (12) Load unload flask. (13) Concrete block shield roof. (14) Containment dome. (15) Air-lock access to dome. (16) Shield trolleys. (17) Labyrinth entry to contained space.

graphite annulus around the fuel, constitute a reflector to reduce neutron escape and fuel.

Nitrogen gas is circulated through the core from an external circuit mounted in a pit beneath the reactor vessel, the nitrogen being heated by a 250-kW heater as it enters the core to raise the core temperature to 800 deg. C. At the top of the core the hot nitrogen is mixed with cooler gas before passing through the reflector; thus the reflector is kept at a maximum temperature of 400 deg. C. At these temperatures it is most important to maintain the purity of the gas, and a purification system is used to remove traces of carbon monoxide and carbon dioxide. The instruments used for core experiments are fitted at the inner-edge of the reflector, and a ring of 30 control-rod holes surround the core.

extrapolate from studies made with zero-energy reactors operating at room temperature.

Moreover, "Zenith" has the advantage that the high operating temperatures are produced by external heating (250-kW), whereas the operating power, merely 100-watt maximum, although sufficient for the nuclear physics measurements, is so low that the activity level in the fuel is not enough to hinder the operation of rearranging the core. The core consists of 235 rods arranged in a nearly cylindrical lattice about 5-ft. long and 4-ft. dia. The fuel elements resemble those of the exponential experiment, but differ in having their ends made of solid graphite. These ends, together with the 3-ft.-thick

"Zenith" is roughly similar in size and shape to the 10-MW high-temperature gas-cooled reactor experiment that is being built at Winfrith as part of the "Dragon" project. The initial programme of work with "Zenith" will be carried out to determine the quantities important in the design of the "Dragon" reactor experiment. Control problems, temperature coefficients and critical sizes will be matters of immediate interest, while measurements of neutron spectra and effective cross-sections will

(Left). Exponential experiment in progress at Winfrith to obtain physics data on detailed design of the "Zenith" core.

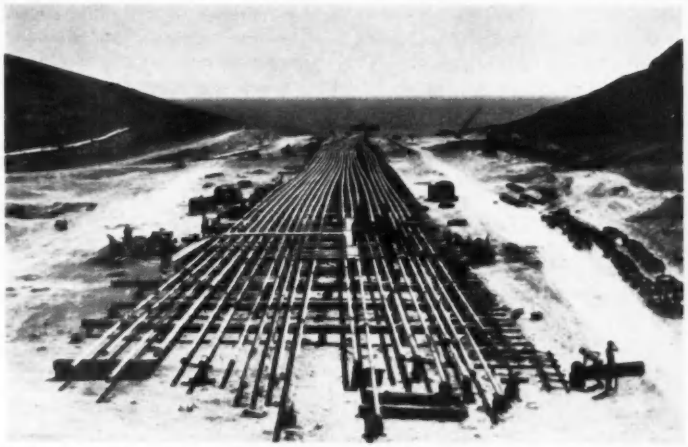
(Right). Top of core of "Zenith" reactor during erection, June, 1959.

improve calculations of such effects as fission product absorption which cannot be observed directly in Zenith. When this work is completed, the reactor will be used for research on high-temperature systems.

Effluent disposal

Under the terms of the Atomic Energy Authority Act (1954) no discharge of radioactive effluents can take place from the Authority's establishments without prior authorisation from the Ministry of Housing and Local Government, and the Ministry of Agriculture, Fisheries and Food. An authorisation granted under this Act does not exempt the Authority from conforming to other regulations applicable to the non-radioactive content of effluent; for example, those designed to prevent chemical pollution. Thus, at Winfrith, the radioactive content of effluent is subject to the controlling Ministries, whereas the Southern Sea Fisheries District Committee have to ensure that the other constituents of the effluent are not harmful to sea fish or sea fishing. To meet these requirements, the Authority carried out an extensive research programme ("Operation Mermaid"), to study the dilution and dispersion of effluent from various proposed discharge points. A joint technical working party, including representatives of the Authority and the Southern Sea Fisheries District Committee, has been set up to establish satisfactory conditions for the discharge of non-radioactive effluents. At the same time, the Authority is supporting a programme of marine surveys and experimental work under the supervision of Professor J. E. G. Raymont, of Southampton University. Surface water and a small amount of purified sewage effluent from buildings in which no radioactive work is done will be discharged, by agreement, to the local rivers. All other wastes will be treated and discharged to sea, Effluents containing radioactive material will drain from buildings into delay tanks in which they will be held until the level of activity is measured. Depending on the activity level, the liquid will be pumped to one of three 200,000 gallon active sea-disposal tanks for batching and final analysis, or diverted to a treatment plant in which the activity level in the liquid will be reduced by chemical treatment. Non-radioactive effluents will be allowed to drain to local pump-houses, and will then be collected in two 200,000 gallon non-active sea-disposal tanks. The necessary analytical work for effluent control will be done in the newly-completed laboratory block in the effluent control area. This area will also contain plant for the storage and treatment of high-level waste, a decontamination centre for plant and equipment and a building for the processing and packaging of solid active wastes.

Two identical pipelines are being installed along a six-mile route to carry the effluent into the sea south of Arish Mell. Each pipeline is designed to handle the estimated effluent from Winfrith. Along the overland route each pipeline will consist of a pipe within a pipe; radioactive liquids will be carried in the inner pipe and other liquids in the outer annulus. A leak-free discharge of radioactive liquid should thus be ensured. Automatic monitors on the outer stream will detect any leak from the inner pipe. The pipes are of mild steel with all welds radiographed to Class I standards and surfaces coated to reduce corrosion. Impressed cathode-cathodic protection against corrosion will be applied to both land and sea sections.



Piping for the dual effluent pipeline being prepared and welded together in long lengths. The pipes will be continued out to sea for a distance of two miles from the coast.

The effluents will be pumped from the main site pumphouse to break tanks at the highest point of the route; from there they will flow by gravity to the discharge points. The break tanks consist of a tank within a tank, the inner one for the radioactive waste and the outer one for the rest (to correspond with the concentric pipe system). As the final part of the pipeline crosses the army gunnery range, the pipes there will be buried at a greater depth to avoid damage.

The landward part of the pipeline will terminate at a reinforced-concrete valve pit on the foreshore. At this point the "concentric" pipes will end; thence the effluent will be carried in four pipes—two for radioactive liquid and two for non-radioactive. On the basis of exercise "Mermaid" the radioactive effluent will be discharged into the sea two nautical miles from the shore. The other effluent will be discharged 50-ft. beyond low-water spring tides. The seaward part of the pipe is welded into 1,200-ft. lengths, surface protected, sheathed in concrete fitted with floats, and stored ready for launching from a jetty which has been built at Arish Mell.

The main contractor for the construction of the Winfrith establishment is the Turriff Construction Corporation Limited. Two contractors are responsible for the effluent pipeline: Constructors John Brown Limited, and Taylor Woodrow Construction Limited, in association with Collins Submarine Pipelines Limited. As previously stated, the main contractor for the "Zenith" installation is The General Electric Co. Ltd.

Contracts for five power transformers totalling over £330,000 have been placed recently with **The General Electric Co. Ltd.** The transformers have been ordered by The Central Electricity Generating Board and include three of 45-MVA rating, one 60-MVA unit, and one of 144-MVA. They will all have cores made from cold-reduced, grain oriented steel.

New Coking Plant for N.C.B.

THE Murton coking plant, with a carbonising capacity of 1,000 tons/day of coal, from which some 250,000-tons of high-grade metallurgical coke will be produced each year, was commissioned recently as part of the National Coal Board (Durham Division) new combined mine, washery and coke-producing unit. In addition to this tonnage of coke, the plant will make available purified gas at the rate of 7½-million cu. ft./day, and the associated by-product plant will produce concentrated ammoniacal liquor, tar and approximately 1-million gal./annum of crude benzole. The main contractors responsible for the Murton coking plant were Woodhall-Duckham Construction Co. Ltd.

Coal for the plant will be drawn from a new shaft, known as the Hawthorn Shaft—from which the planned output of 1.5-million tons/annum of saleable coal will be the highest in the country from a single shaft. It will be served by two electric winders drawing coal in 8-ton capacity skips from two levels at 1,070 and 1,430-ft., with underground locomotive haulage roads of some 18 miles total length, to three satellite collieries—Murton, Eppleton and Elemore.

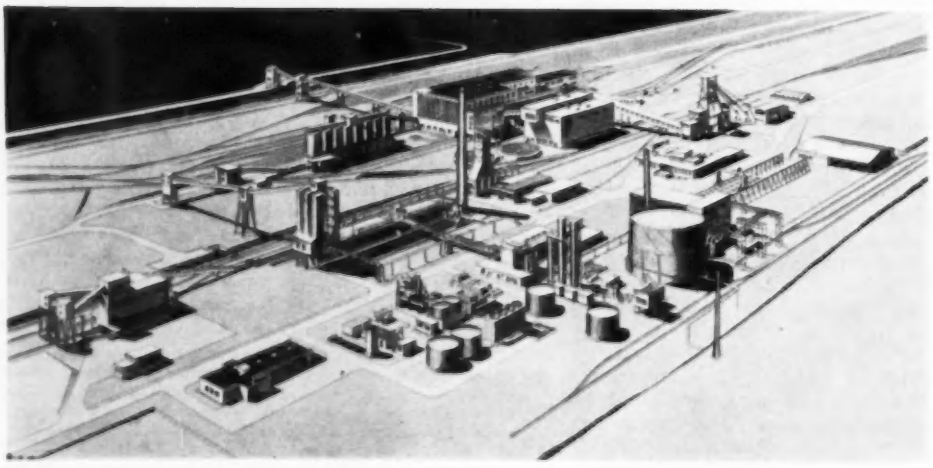
The new coal-preparation and washery plant has a capacity of 750 tons/hr. of run-of-mine coal; that of over $\frac{1}{16}$-in. size being cleaned by dense medium separation in a Chance sand-flotation washery; the minus $\frac{1}{16}$-in. material being handled in a Unifloc froth-flotation plant. Coal can be brought in from other collieries for washing if required, up to a maximum rate of 400 tons/hr.

From this plant, coal, ½-0-in. to 1-0-in. size, is delivered to blending and storage bunkers at the rate of 250 tons/hr. The bunkers, of reinforced-concrete construction, are arranged in a single line of eight compartments, each having a capacity of 400-tons. Coal is delivered from these bunkers by a belt conveyor system, provided with the means to include blended coal reclaimed from storage and coke breeze, to a coal-crusher house where it is fed to a swing-hammer pulveriser, direct-driven by an electric motor through a flexible coupling, and capable of reducing the coal so that 80 per cent. passes through a $\frac{1}{8}$-in. square mesh screen at the rate of 200-tons/hr.

Provision has been made for a second crusher to be installed at a future date. The crushed blended coal is then discharged to a belt-conveyor, which alternatively receives uncrushed coal from a by-pass chute provided at the crusher. This conveyor terminates at a combined transfer station and vehicle-loading hopper, from where either crushed coal is delivered to further conveyors, and then to the 2,200-ton capacity coke-oven coal-bunker, or uncrushed coal is passed to the vehicle-loading hopper. The latter has a capacity of 50-tons and is the loading point for vehicles carrying coal to the open storage area. From the blending bunkers to the coke-oven bunker, the coal-handling plant has a capacity of 200-ton/hr.

The actual coke oven plant comprises two batteries of 25 W-D Becker Combination Underjet ovens, the layout of the plant being so arranged that a third battery can be added in the future. The ovens are each 40-ft. 9¾-in. long between doors, 13-ft. high, and have an average width of 18-in. The capacity of each oven is 735-cu. ft. and the complete installation is designed to carbonise 1,000-tons/day of coal having a moisture content of 9 per cent. The ovens are designed for heating either by coke-oven gas, when the Underjet system is employed, or alternatively by producer gas, should producer-gas mains be added in the future.

The coal-charging car provided is of the portal-type, having four hoppers with a total capacity of 17-tons. It is electrically-operated and runs on rails on top of the battery. When carbonisation is complete, the coke is discharged by a pusher machine. This is a combined unit which, in addition to discharging the hot coke, travels the length of the batteries, levels the charge of coal in the oven and removes and replaces the oven doors on the pusher side. The hot coke discharged from the ovens is received in a coke-quenching car which travels to a quenching

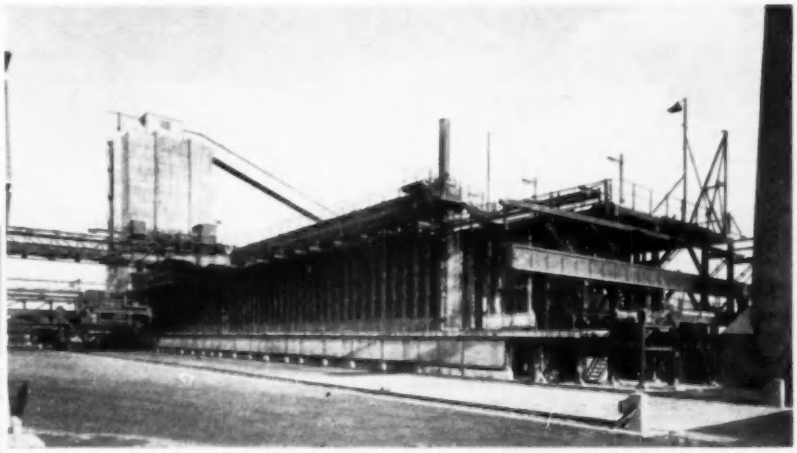


A perspective wash drawing showing the layout of the new Murton coking plant, recently commissioned for the N.C.B. (Durham Division).

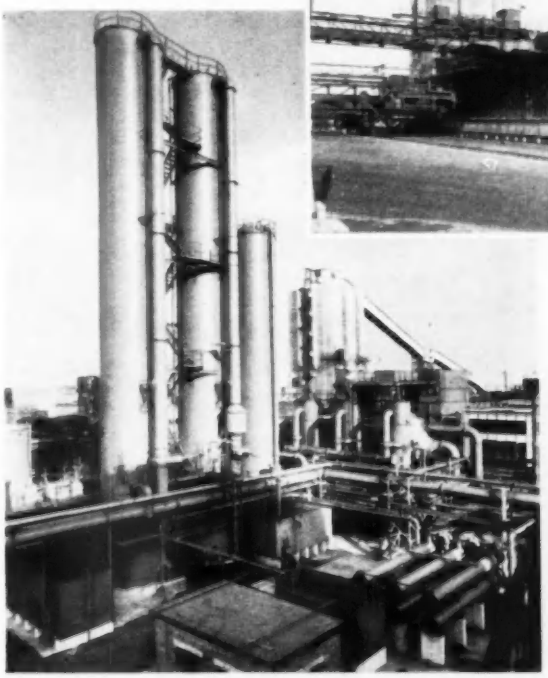
station where a predetermined quantity of water is sprayed on the coke. The quenched coke is then taken to a 150-ft.-long coke wharf, where it is discharged from the car. The coke-handling and screening plant produces six grades of coke, and incorporates coke-cutting machinery and provision for road and rail loading. Facilities are also provided for the stocking and reclaiming of coke.

The by-product recovery plant associated with the coke oven is of the indirect-type, in which the gas is

(Right). *The pusher side of the coke-oven batteries.*



(Below). *General view of the by-product plant.*



cooled and washed for the recovery of tar and ammoniacal liquor.

Two turbine-driven gas exhausters of the two-stage double-flow type are provided to withdraw the gas from the ovens and primary coolers, and to discharge it through the by-product equipment. The exhausters are of Richardsons, Westgarth Co. Ltd. manufacture, one being normally in operation, with the other as standby. Each is capable of handling the total make of gas from the present plant and the future extension. A maximum volume of 874,000 cu. ft. of gas/hr. can be passed by each exhauster, delivering against a back-pressure of 2 lb./sq. in. Each exhauster is direct-coupled to a high-speed impulse-type steam turbine operating with steam at a pressure of 150 lb./sq. in. and exhausting against a back pressure of 15 lb./sq. in.

Gas having passed through the by-product recovery plant is delivered to the crude benzole recovery plant (which as previously stated is designed to produce 1-million gal./annum) and then to a 200,000 cu. ft. capacity, single-lift, spirally-guided gasholder supplied by Newton Chambers & Co. Ltd.

Producer gas, for diluting the surplus coke-oven gas to a suitable calorific value for town use, is manufactured in two Gibbons Heurtey H.W.J.18 gas-producers. These are 4-ft. 11-in. dia., and of sufficient capacity to serve the present plant and the future extension.

The gas thus diluted is delivered to the dry purification plant by two Davidson & Co. Ltd. 'Sirocco' motor-driven, oil-cooled booster fans, one acting as standby, and each capable of delivering 380,000 cu. ft./hr. of gas. There are three gas-boosters, supplied by Belliss & Morcom Limited, each capable of compressing 5.33-million cu. ft./day of gas. The boosters which pass the gas to the gas grid are standard with machines installed at other coking plants in the area, and are of the two-crank, single-stage, double-acting vertical type; two are motor-driven, and the third steam-driven, the latter being complete with variable-speed control gear. Each booster is equipped with an after-cooler having an area of some 650-sq. ft.

Crude concentrated ammonia liquor of 25 per cent. strength is produced from the crude coke-oven ammonia liquor in an automatically-controlled plant supplied by R. & J. Dempster Limited, Elland, Yorks., and designed to handle some 2,500 gal./hr.

Centralised instrumentation and control

Probably the most outstanding feature of the new coking plant is the centralised instrumentation and control systems provided for the operation of both the by-product and benzole plants and the coal and coke-handling plants. The principal system is that associated with the by-product and benzole plants where a graphic panel some 40-ft. in length provides minute-by-minute information relating to the flow of coke oven gas, producer gas, ammoniacal liquor, tar, benzole, wash-oil, water, steam and air.

The panel, designed by Woodall-Duckham Construction Co. Ltd., and constructed by Foxboro-Yoxall Limited, consists of the central graphic section with wing panels at each end. The right-hand wing is provided, primarily, to present essential information required for

budgetary control which falls outside the scope of the graphic presentation. In particular, instruments on this wing record steam pressures, and record and integrate steam-flows to individual plants. The left-hand wing contains two switch potentiometers, a multi-column mercury manometer, and an annunciator board which forms part of a comprehensive alarm system.

The coal-handling plant control desk incorporates an illuminated mimic diagram panel which records all the information necessary for the required operation of all machines and conveyors from the delivery of washed coal at the blending bunkers until it is discharged into the ovens bunker. "Bunker full" indication is obtained by the use of Tektor electronic level indicators supplied by Fielden Electronics Limited.

The control desk for the coke-handling plant is provided with a diagram panel and various indicator lamps to show which sections of the plant are in operation, and whether the coke hoppers are full or empty. High- and low-level indication for the hoppers depends upon gamma-rays from Cobalt-60 radio-active isotopes accommodated between the sides of the coke bunkers and the adjacent walls. The operator can control the correct sequence operation of the whole of the handling and screening system right through to the marshalling, weighing and loading of empty wagons and the weighing and marshalling of full wagons.

The actual pushing operation at the coke-oven is controlled by the W-D Gamma Interlock System, which again utilises Cobalt-60 isotopes, and automatically ensures that a charge cannot be pushed until both doors have been removed and the pusher machine and coke guide correctly aligned with the oven. Duplicate means for stopping the operation in an emergency are provided. The pusher machine is operated from an armchair unit, from which all the electric motors on the machine are controlled. This is thought to be the first example of a control of this type being fitted to a pusher machine.

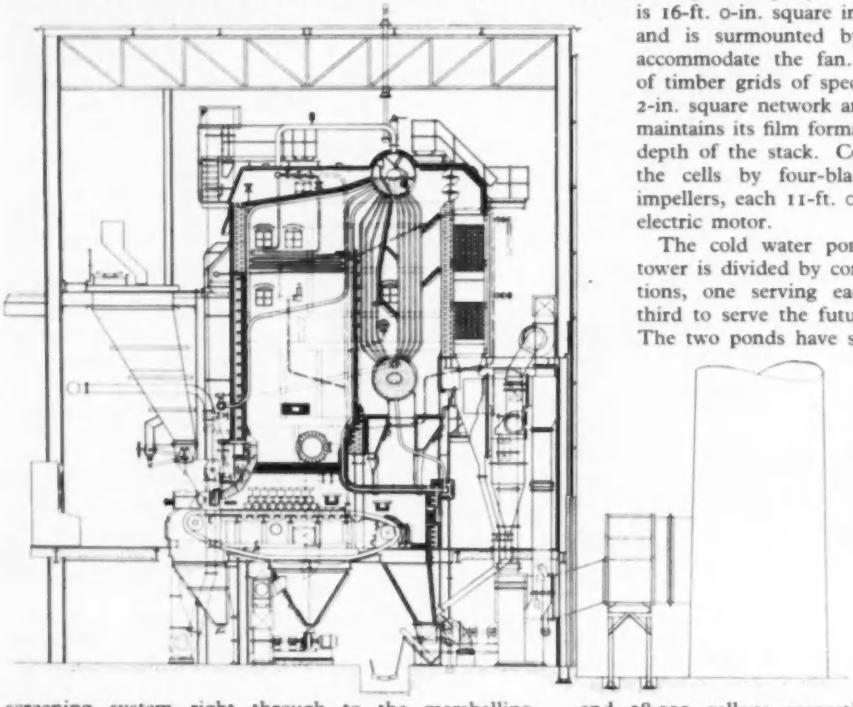
Water-cooling and recirculation

The water-cooling plant associated with the coke-oven comprises two independent, closed re-circulation systems, each complete with a cooling tower, cold wells and the necessary suction and delivery water piping. Make-up water for both systems, as well as for other uses on the site, is pre-treated in a separate water-treatment plant, which will be referred to later in these notes.

The cooling towers were supplied by Film Cooling Towers (1926) Limited, and are of the induced-draught type, each comprising two independent cells so arranged that an additional cell can be added to each tower when the plant is extended. The two cells of the first system are capable of cooling 55,000 gallons of water/hr. to a temperature of 78 deg. F., whilst those of the second system can cool 50,000 gal./hr. to a temperature of 72 deg. F., both with a wet bulb temperature of 64 deg. F. Allowing for one cell of each tower being temporarily out of commission, the normal throughput can be maintained, though at slightly reduced efficiency. Each cell is 16-ft. 0-in. square inside and 27-ft. 6-in. high, and is surmounted by a cylindrical funnel to accommodate the fan. The cell filling consists of timber grids of special construction forming a 2-in. square network and ensuring that the water maintains its film formation throughout the entire depth of the stack. Cold air is induced through the cells by four-bladed, laminated hardwood impellers, each 11-ft. 0-in. dia. and driven by an electric motor.

The cold water pond provided beneath each tower is divided by concrete walls into three sections, one serving each existing cell, and the third to serve the future cell when it is erected. The two ponds have storage capacities of 41,000 and 38,000 gallons respectively for the two cooling systems. Five motor-driven centrifugal vertical-spindle water pumps are provided for various duties.

Electricity is received at the site from the N.C.B.'s local power house switchroom at 3.3-kV and passed to two substations—one to serve the coke-oven and the coal and coke-handling plants, and the second to serve the by-product plant, administration block, workshops, laboratories and gas purification plant. The main 3.3-kV switch-gear in the substations is of the LA23T-type manufactured by A. Reyrolle & Co. Ltd., and each



Cross section of one of the three bi-drum, radiant-heat, natural-circulation boilers supplied by Clarke, Chapman & Co. Ltd. Each unit is designed for an m.c.r. of 20,000 lb./hr., at 615 lb./sq. in. and 815 deg. F. from feedwater at 200 deg. F.

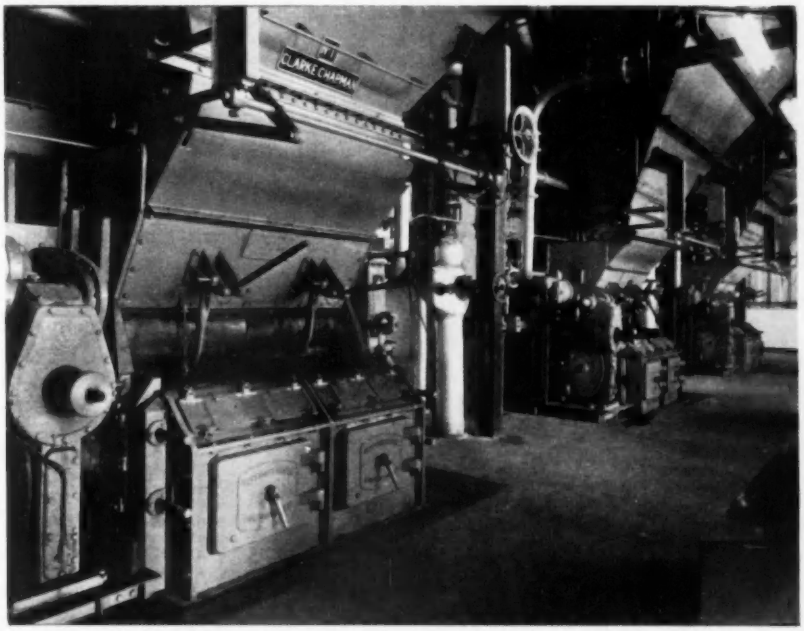
sub-station has a single 750-kVA, 3.3-kV/550 volt, 3-phase transformer. Low-tension gear comprises Reyrolle type "D1" and "E7" circuit-breakers which serve nine Belmos starter switch-boards. In general, motors averaging over 100-h.p. are connected to the 3.3-kV supply, i.e., those for the gas fans, gas booster, coal crusher, dust extraction fan, etc.

The motors provided are mainly of the totally-enclosed, fan-cooled type supplied by either the General Electric Co. Ltd., or Metropolitan-Vickers Electrical Co. Ltd. All are suitable for direct-on-line starting except the motors for the coal crushers and gas boosters, which are slipring and synchronous machines respectively. The synchronous motors driving the gas-boosters were supplied by Mather and Platt Limited, and are designed to run in conjunction with gas-circulating fans, and so interlocked that should the gas fans stop, the booster or boosters will automatically shut down.

Steam and power supplies

The power station building was constructed by the Dowsett Engineering Construction Co. Ltd., the necessary steelwork design and erection being carried out by Redpath Brown & Co. Ltd. The main plant installed comprises three boilers for supplying steam to the coking plant, and to a back-pressure turbo-alternator set.

The solid fuel supply for the boilers is delivered to a ground bunker by bottom-opening trucks. It is then transferred to duplicate hoppers by means of a telpher machine, and is then transported to the main fuel conveyor feeding the boiler bunkers by means of a travelling tripper. If blended fuel is required the correct proportions of coal and coke breeze are pre-set on each hopper and automatically maintained by weigher equipment supplied by Simon Weighers Limited. The fuel-handling plant was installed by W. J. Jenkins & Co. Ltd.



View along firing aisle, showing fronts of the three Clarke, Chapman boilers.

The steam generating plant was supplied by Clarke, Chapman & Co. Ltd., Gateshead, and comprises three bi-drum, radiant-heat, natural-circulation water-tube units, each being designed for an m.c.r. of 20,000 lb./hr., at 615 lb./sq. in. and 815 deg. F., from feedwater entering the economiser at 200 deg. F., and when burning South Hetton smalls or coke-oven gas, or a combination of both. The firing equipment for each unit comprises an L-type travelling-grate stoker made and supplied by International Combustion Limited, for the solid fuel, while there is one "Gako" T.B.-type gas-burner fitted in each combustion chamber side-wall.

The front wall of the combustion chamber is cooled by 3½-in. o.d. tubes at a nominal pitch of 6-in., and backed by a refractory wall and insulating blocks. Alternate tubes are carried across the combustion chamber from the front wall immediately below the superheater, and then upwards, in front of the rear wall, into the top drum. The remaining front wall tubes continue upward and backward into the top drum, to form the front and roof of the upper chamber. The rear wall is cooled by similar tubes at 6¾-in. pitch, the bottom of the tubes being arranged horizontally to support the rear refractory arch.

Hot gases from the combustion chamber flow upwards through the self-draining type superheater and through the circulating tubes between the drums, the gas flow through the tubes being directed by firebrick baffles. From the boiler, the gases travel downwards through the economiser, leaving at a temperature of 349 deg. F., and then through dust extraction plant of the mechanical type manufactured by James Howden & Co. Ltd. The cleaned gases are extracted by an induced-draught fan, and are discharged into a common flue leading to the single chimney.

Feedwater at a temperature of 200 deg. F. enters the economiser and is raised to 348 deg. F. The economiser, supplied by Senior Economisers Limited, is of welded construction, with cast-iron sleeves shrunk on to the tubes to provide additional heat-absorbing surface. The water leaves at the top of the economiser and is fed into the boiler top drum. It then flows down through the rear bank of circulating tubes into the bottom drum, where the greater part of the water is carried by feeder pipes to the headers at the bottom of the combustion chamber walls. This part of the water then continues up the tubes forming these walls and into the top drum. Water is also circulated up through the front bank of inter-drum tubes and into the top drum. Here the steam is released by a system of baffles, before passing through scrubbers into the superheater.

The saturated steam from the top drum is piped to one end of the superheater top header, which is divided into two sections by a diaphragm at the centre. The steam then flows downwards through one half of the bank of elements to the lower header and along this header into the other half of the bank, through which it flows into the outlet section of the top header.

Draught plant for each unit comprises a forced-draught fan, induced-draught fan and secondary-air fan, manufactured by James Howden & Co. Ltd. Sootblowing equipment supplied by Clyde Blowers Limited consists of one electrically-operated retractable blower with a stroke of approximately 8-ft., arranged to clean the furnace tubes and superheater, and one hand-operated multi-jet blower for cleaning the boiler circulating tubes.

The mountings and fittings were supplied by Dewrance & Co. Ltd., the main instruments and control panels by George Kent Limited, and "Tension" type feed-water regulating equipment by Copes Regulators Limited. The boilers are fitted with conventional operating instrumentation and with flame-failure indication and warning equipment for the gas burners. Normally, two boilers are on load, providing approximately 33,000 lb./hr. of steam via an all-welded high-pressure ring main to the turbo-alternator.

Three boiler feed-pumps, supplied by Harland Engineering Co. Ltd., are installed, each being of the multi-stage centrifugal, "Spiroglide" geared type, designed to deliver 40,000 lb./hr. of water at a temperature of 210 deg. F., at a pressure of 725 lb./sq. in.; and at zero output 845-lb./sq. in. Two of the pumps are driven by electric motors, and the third by a Hayward Tyler-Terry turbine operating at 160-lb./sq. in., and 475 deg. F. Mechanically-operated leak-off valves, combined with the discharge non-return valves, are fitted on all pumps and they are each capable of delivering 7,200 lb./hr.

The ash disposal plant was also supplied by W. J. Jenkins & Co. Ltd., the ash discharged by paddle dischargers on the boilers being taken by belt conveyor to an ash-pit, where it is periodically removed by the telpher machine associated with the coal-handling installation. This machine can, in addition, in the event of failure of the sludge pump, also remove the water-treatment plant sludge.

Water supplies and treatment

Water supplies are obtained from a sand feeder reservoir on the site, and treated in a fully-automatic plant, supplied and installed by John Thompson-Kennicott Limited, and comprising a lime precipitation unit followed by a filter battery, from which the water passes to a storage tank. This first section of the plant has a capacity of 160,000 lb./hr., approximately 100,000 lb./hr. of which is utilised as make-up for the cooling frames, and a further quantity passed as required to other services in the coking plant. The remainder—water for boiler feed purposes—is passed to the second section of the plant which comprises a base-exchange unit with a polystyrene head resin bed, and then to a fully-treated storage bank.

Duplicate, triple-effect evaporator units, each having a capacity of 25,000 lb./hr., are provided to produce distilled water. These were supplied by Aiton & Co. Ltd. and are designed to operate initially with live steam at 160 lb./sq. in. and 470 deg. F., and ultimately with steam at 600 lb./sq. in. and 800 deg. F. This provision was made in order that the turbine throughput would initially include the evaporator steam, which would thus load the turbine during the early days of the operation of the coking plant when the steam consumption was not such as to provide the full-load requirements of the turbo-alternator.

Turbo-alternator

The turbine installed was supplied by W. H. Allen, Sons & Co. Ltd., and drives an alternator of Mather & Platt Limited, manufacture. It is a five-stage impulse type, back-pressure machine designed for an m.c.r. of 860-kW, when supplied with 33,000 lb./hr. of steam at a stop-valve pressure of 600 lb./sq. in. and a temperature of 800 deg. F., with steam conditions at the turbine exhaust of 160 lb./sq. in., and 475 deg. F.

In parallel with the turbo-alternator, duplicate pressure-reducing and attemperating equipment is provided, each set being capable of carrying the coking plant steam load. The pressure-reducing valves are of the needle pattern, right-angle type, and the attemperating equipment, which is installed downstream of these valves, is of the direct-contact spray-type. These units were supplied and installed by James Gordon & Co. Ltd., and are arranged for automatic or manual control, being designed to take over the steam supply immediately upon failure of the turbo-alternator set, or during periods of maintenance.

The 860-kW, 1,075-kVA, 0.8 p.f., 3-phase, 50 c/s, 3.3-kW alternator is of the duct-ventilated, single-pedestal bearing salient-pole revolving-field type, fitted with an air filter, the turbine speed of 11,000 r.p.m. being reduced to the alternator speed of 1,500 r.p.m. by means of an Allen-Stoeckicht planetary double-helical type epicyclic gear arranged to carry part of the alternator weight. The set is arranged for running in parallel with the public electricity supply.

In conclusion, we record our acknowledgments to the Woodall-Duckham Construction Co. Ltd., who supplied much of the technical information.

The Central Electricity Generating Board have awarded **Worthington-Simpson Limited** a contract covering the design, supply and erection of condensing plant for two 300-MW turbo-alternators to be installed at West Thurrock power station, C.E.G.B., Eastern Division. Each plant includes one condenser having a total cooling surface area of 165,000 sq. ft., three 50 per cent. capacity, horizontal extraction pumps, and four 33 1/3 per cent. capacity hydraulic rotary air-pumps, together with all associated piping and valves. Each condenser is designed to condense approximately 1,280,000 lb./hr. of steam at an absolute pressure of 1.1 Hg. when supplied with 135,000 g.p.m. of circulating-water at 55 deg. F. The extraction pumps will each have a capacity of 1,270 g.p.m. against a total head (including vacuum) of 260 ft. Air-extraction equipment will be of the latest hydraulic rotary design, and will match up with similar equipment already being supplied for smaller machines at the same station. The condensers will be the largest ever manufactured by Worthington-Simpson. The first set is to be ready for commissioning in 1963, and the second set in 1964.

* * *

Mr. S. S. Scott, O.B.E., M.A., chief personnel officer of the Central Electricity Generating Board since its formation, vacated that appointment on September 30th, and has been succeeded by **Mr. Harold C. Spear,** formerly chief personnel officer to British Overseas Airways Corporation. Mr. Scott will, however, continue for some months as an adviser on labour relations matters.

New Atomic Power Centre for English Electric Company

THE Atomic Power Centre of The English Electric Co. Ltd., at Whetstone, near Leicester, was opened officially on July 24th, by the Minister of Power, Lord Mills. Whetstone is the headquarters of the English Electric-Babcock & Wilcox-Taylor Woodrow consortium which designed and is building the 500-MW nuclear power station at Hinkley Point, in Somerset. In addition to the atomic power work, the English Electric mechanical engineering laboratories and its gas turbine division and small steam turbine section are also situated at Whetstone.

The original factory on the site was built in 1942 for Power Jets (R. & D.) Limited, the company set up to further the initial development work of Sir Frank Whittle in the field of jet propulsion. Later, the works became part of the National Gas Turbine Establishment. In 1953, the N.G.T.E. started to transfer their staff and equipment to Pyestock, and The English Electric Company began to take over, until in 1956 they were in complete occupation of the works. There are now over 2,500 employed at Whetstone, of whom approximately 450 are highly qualified research, development and engineering staff.

Nuclear research and development

The work of the Research and Development Department of the Atomic Power Division involves both the experimental and theoretical aspects of present and future design of nuclear power stations. The economy of nuclear power stations and their safety depends largely on the performance of the fuel element, and a great deal of activity is devoted to the development and proving of a reliable design with the best possible performance. This involves considerable chemical and metallurgical work on fuel element materials such as magnesium alloys, beryllium and uranium, as well as fluid flow and heat transfer experiments to obtain the most efficient transfer of heat from the element to the coolant gas. With the commissioning of the new toxic laboratories at Whetstone The English Electric Company is able to manufacture complete fuel elements for proving in a reactor.

Many problems in a nuclear reactor relate to wear and lubrication under conditions of great heat and atomic radiation, and much experimental work into the problems involved is carried out under reactor operating conditions. In addition, extensive mechanical development work is carried out by the test of prototype machinery, such as fuelling machines and grabheads, control rod hoists and gas circulators.

Apart from the more usual metallurgical and mechanical test facilities, Whetstone is provided with the equipment necessary for special tests on reactor materials and in particular for fuel element materials. These facilities enable the problems of corrosion, creep strength, thermal stability and mechanical and other properties to be studied, and make accurate data available for design purposes.

The theoretical work of the Research and Development Department is supported by extensive computing facilities of both digital and analogue types. An English Electric "Deuce" digital computer provides a service for all the Whetstone laboratories and two analogue computers are used in the analysis of transient conditions in the reactor. A third analogue machine, which is expected to be the largest of its type in Europe, is shortly to be completed and will further increase the capacity for study of reactor performance and control problems. All three analogue computers have been designed and built at Whetstone.

Gas turbines

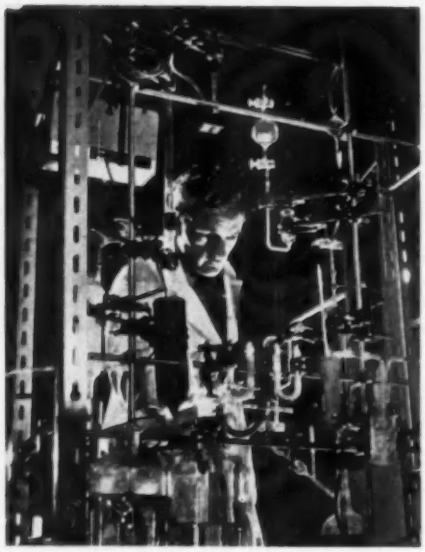
Part of the now much modified and enlarged works is devoted to the development and production of long-life industrial gas turbines for driving electric generators, compressors, pumps and locomotives. The English Electric range of industrial gas turbines extends to the largest units yet installed in the United Kingdom. These sets, rated at 20,000 kW each and two in number, have been installed at the Royal Aircraft Establishment at Bedford where they drive variable speed alternators supplying electric power over a range of frequencies for supersonic and other wind tunnel drives.

Two smaller turbines of standard design are in production for a variety of duties at home and

The Minister of Power (centre) photographed on the occasion of the official opening of the Whetstone laboratories. Mr. H. G. Nelson, managing director, The English Electric Co. Ltd., is seen on the left of the Minister.

overseas. The first, known as the EM 27, covers the output range 2,300 to 3,000 b.h.p., while the larger EM 85 engine is rated at 8,000 b.h.p. Both are two-shaft open cycle units combining simplicity with light weight and small size. The minimum of foundations are required for their installation and building costs are considerably less than for other prime movers of similar capacity. Suitable fuels include distillate and certain other liquid fuels; natural, oil refinery and many other combustible gases. Recent applications include units for electric power generation and for driving liquid pumps and centrifugal gas compressors.

Another interesting example of the work of the Gas Turbine Department is the direct-drive gas turbine locomotive powered by an EM 27 which is in course of development at the present time.



(Left). Apparatus for the examination of the way in which an atomic reactor behaves with the fuel elements and the modulator.

(Right). A view in the "Toxic" laboratories showing tests being carried out to determine the heat flow properties of atomic fuel element materials.

Small steam turbines

Steam turbines of all types and sizes have been made by English Electric since the early years of the century, and Whetstone is now the home of a separate section formed to take over the development, design and manufacture of small steam turbines within the Steam Turbine Division of the company. This section concentrates on small geared units of up to 5,000 kW and covers the complete field of condensing, back-pressure and pass-out design. Because the power requirements of individual factories are small in comparison with that of whole communities, the power producing unit needs to be small and special problems arise in the design and production of the small prime mover. These machines now being designed and built at Whetstone incorporate all the wealth of experience and background provided by half a century of steam turbine production by the company.

Some interesting examples going through the Whetstone workshops include back-pressure turbo-generator sets for marine applications, straight condensing machines for driving turbo-blowers and reciprocating air compressors.

Mechanical engineering

The Mechanical Engineering Laboratory was established in 1955 to undertake fundamental and long-term research and development with two principal objectives in mind. One of these was to carry out work on problems of general interest to a number of product divisions in the company and on advanced topics likely to be of wide value in the future. The other was to carry out sponsored work for product divisions on specialised subjects for which the divisions' own laboratories might not be appropriate.

In the few years since its inception, the mechanical engineering laboratory has grown to occupy some 37,000 sq. ft. of laboratories and offices, and expansion is still taking place. It is staffed by scientists, technologists and assistants and it has laid the foundations for an expanding volume of work of immediately recognised significance to the future development of the company's products.

The work of the laboratory falls under four main group headings: 1—Mechanics of solids; 2—Mechanics of fluids; 3—Heat; 4—Mathematics. The breakdown by subjects of the four groups is: *Group* 1—(A) Surface properties of solids; (B) stress analysis, strength of materials; (C) vibrations. *Group* 2 (A) Fluid machines, turbulent flow; (B) fluid films; (C) servo mechanisms. *Group* 3 (A) Heat transfer; (B) thermodynamics; (C) combustion. *Group* 4 (A) General mathematical studies and services; (B) digital computer applications.

To help these and other laboratories at Whetstone a comprehensive general metallurgical and chemical laboratory has been established with a qualified staff of 12, together with an extensive technical library and data department under a librarian and 26 assistants.

Production facilities

Whetstone, although predominantly a design and development centre, nevertheless, includes a substantial production facility both to support the development and

research programme and to manufacture the products designed and developed there.

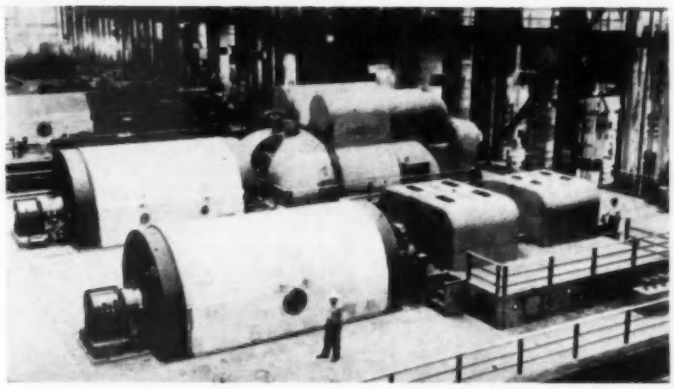
The range of industrial gas turbines and small steam turbines made at Whetstone demands a wide variety of production facilities which are also eminently suitable for development work. The careful balance maintained in the machine tool capacity ensures a prompt and efficient service to the development laboratories to fulfil a demand ranging from small uranium test pieces, complex shaped fuel element test cans and electronic apparatus to fabricated spiral casings for water turbine research and aerodynamic models in plastics. A comprehensive instrumentation service is also operated covering design, construction, calibration and maintenance.

While most of the equipment required for atomic power stations is manufactured at other works of the company and its partners, some of the very specialised reactor components are made and tested at Whetstone. The reactor fuelling machines, for example, have necessitated the construction of a special workshop for assembly and test purposes with heavy lifting facilities and a deep pit in which a pressurised test facility will simulate reactor conditions.

The large-scale use of graphite in Calder Hall type atomic power stations now under construction in Britain possesses its own unique production problems. Graphite varies significantly in density and accurate analysis is necessary to determine how it shall be selected, and subsequently machined, to fit into that part of the reactor pile most suited to give the best nuclear efficiency. It was therefore considered best to site the graphite machining department at Whetstone where "on-the-spot" contact could be maintained between the production and analytical sections. The machining of graphite from the receipt of the extruded billets to the variety of accurately shaped bricks and tiles must be carried out with special precautions to prevent contamination of the graphite. Clean conditions must be ensured at all times and great attention is paid to dust extraction and the clothing of the workers. The machine shop has been equipped with the latest automatic machine tools and material handling equipment.

LARGEST TURBO-GENERATOR FOR COMMONWEALTH

The 200-MW Parsons turbo-generator now in service at the Richard L. Hearn Generating Station, Toronto, is the largest turbo-generator yet installed in the Commonwealth. This machine is the first of four 200-MW sets ordered from Parsons by the Hydro Electric Power Commission of Ontario for installation in the Hearn station. The installation of these units will bring the station capacity to 1,200-MW, making it the largest in Canada, and probably in the world, with machines made by the one manufacturer. As can be seen from the accompanying illustration the machine is of the cross-compound design, one line consisting of an h.p. and i.p. turbine driving a 100-MW hydrogen-cooled generator at 3,600 r.p.m. The other line comprises a second i.p. turbine and l.p. turbine driving a 100-MW hydrogen-cooled generator at 1,800 r.p.m. The operating steam conditions are 1,800 lb./sq. in. at the stop valve, 1,000 deg. F. temperature with reheating of the steam between the h.p. and first i.p. turbines to a temperature of 1,000 deg. F. The 60 c/s generators operate at 13,800 volts and 0.85 p.f. Both are of the normal hydrogen-cooled design employing rotors of the direct-cooled type operating in hydrogen at a pressure of 30-lb./sq. in. Excitation is provided by separately driven exciter units. These machines are the largest turbo-generator sets to be exported from England at the present time.



The 200-MW turbo-genernator set supplied by C. A. Parsons & Co. Ltd., and installed in the Richard L. Hearn generating station, Toronto. This is the first of four such machines to be installed in the station.

The British Thomson-Houston Export Co. Ltd., now incorporated in **Associated Electrical Industries Export Limited,** recently received an order through its agent, Lic. J. O. Aragon in Mexico City to construct and equip a complete steam power station for the Federal Electricity Commission of Mexico. The station will be built at Juchitan in the state of Oaxaca, and is to be in commission early in 1961, supplying electricity to an area on the Pacific Coast. Standardised designs have been developed by A.E.I. for steam electric power stations, complete with buildings and plant, and, although in this case foreign competitors made similar claims, it is understood that the accepted design by A.E.I. was nearer completion and capable of construction in the shortest time. Thus, the order was placed in this country in spite of strong competition from American and European firms. Generating plant will be manufactured by A.E.I. Turbine-Generator Division at their works in Rugby and Glasgow. Initially, two 6,250-kW turbo-generators will be supplied for operation with turbine stop valve steam conditions of 400 lb./sq. in., 752 deg. F., and with condenser vacuum of 27.5 in. Hg. The generators will be rated at 7,812.5-kVA, 0.8-p.f., and will supply 60 c/s, 3-phase, a.c. at 13.8-kV. Two boilers, each rated at 72,500 lb./hr., are to be supplied by International Combustion Limited. The cooling-towers for this installation will be supplied by Film Cooling Towers (1925) Limited, London. All the miscellaneous equipment is included in the contract to complete the initial stage of the power station, which is to be constructed to accommodate a third turbo-generator set and associated boiler plant at some future date. The contract includes the designs for the buildings and civil engineering works; these have been prepared by Norris Consultants Limited, Bristol, working in conjunction with A.E.I. Turbine-Generator Division.

Lt. Col. H. Riggall, D.L., J.P., is relinquishing his position as managing director of Ruston & Hornsby Limited on December 31st next, but is to continue his association with the company as deputy chairman. He will also remain chairman of Ruston & Hornsby (Australia) Pty. Ltd. **Mr. V. R. Prehn** and **Mr. G. W. Bone** have been appointed joint managing directors of Ruston & Hornsby Limited, as from January 1st next. Mr. Prehn is at present assistant managing director and Mr. Bone is a director.

RECENT Equipment AND Accessories

Centralised level control

Fielden Electronics Limited, announce that a development of their Tektor Minor level controller now makes it possible for up to 150-ft. of coaxial cable to be used between the probe and electronic unit. Further, multiple construction of the electronic units enables centralised or grouped indication of level. A single Tektor consists of a probe connected to an electronic unit, the probe being installed on the container. The increase in interconnecting cable length means that

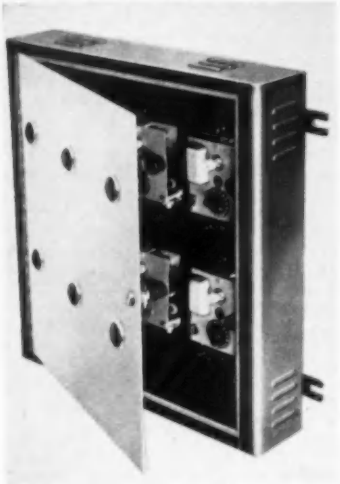


Fig. 1 (left). Electronic unit of the Tektor Minor level control. (Fielden Electronics Ltd.)

the unit may be conveniently situated at ground-level for ease of access or maintenance. If centralised level control is required this extension cable length enables all electronic units to be brought together from different parts of the plant and housed in one case. The interconnecting coaxial cable is supplied with the instrument and no other cables are required from probe to unit. Installation costs are therefore reduced with multiple construction because only one mains supply cable need be run to the multiple unit. (*Fielden Electronics Limited, Wythenshawe, Manchester.*)

Refuse Disposal

Riley (IC) Products Limited recently acquired the manufacturing rights for the Pillatt incinerator and now market this product as the Riley-Pillatt incinerator. This unit is already well-established in its field and is widely known for its efficiency, safety and hygienic operation. Combustion is claimed to be virtually smokeless when the usual forms of general refuse are being burnt and it thus fulfills the new demands of the Clean Air Act. The incinerators are encased in cast-iron, and can be positioned in the open or under cover. Two important features are the controlled openings for the admission of secondary air, and a baffle chamber designed to direct the waste gases downwards over a water seal before entering the flue. A mild-steel chimney is generally supplied with each unit but it can be connected by smoke piping to an existing flue or chimney. (*Riley (IC) Products Limited, Nineteen Woburn Place, London, W.C.1.*)

Fig. 2 (below). The Riley-Pillatt incinerator is claimed to achieve virtually smokeless combustion. Riley (I. C.) Products Ltd.

Pipe cleaning at a tar distillery

The distillation plant at the Preston works of Lancashire Tar Distillers Limited has recently been thoroughly cleaned after distilling more than 112,000 tons of crude coal tar. The plant concerned included pipes and tubes of the convection-type tar heater, heat-exchangers and condenser. The deposit encountered

Fig. 3 (right). Cleaning the tubes of a convection-type tar heater with "Lagonda" equipment. (Consolidated Pneumatic Tool Co. Ltd.)

normally consisted of a dense, gummy tar residue, which becomes extremely hard when overheated and carbonised. It usually builds up in irregular and uneven shapes along the inner walls of pipes and tubes, and is rarely of even thickness. Its removal from the various sizes of pipes, bends and tubework of the heaters and heat-exchangers was effected by using "Lagonda" tube-cleaning equipment supplied by the Consolidated Pneumatic Tool Co. Ltd.—a range of three types of pneumatically operated motors coupled to a variety of types of cutter head being used. For the convection-furnace-type tar heater, incorporating two banks of heating coils which carry 202 tubes, of 3½-in. i.d. in each bank—"Lagonda" series—1,100 motors were used, these also being used for the bends which were dismantled from the coils prior to cleaning. The average time to clean one 15-ft. length of heater tube varied from 20-min. to 1-hr., using first a cutter head and then a swing-frame type head. The pitch/tar heat-exchanger consists of some 335 tubes of ⅝-in. i.d., the length of each being 14-ft. These tubes had become completely blocked with a dense hard deposit of carbonised pitch. To clear these,

an "El Paso" cutter head was used in conjunction with a 3075 "Lagonda" drill, this unit being fitted with a water-feed, to supply water at a pressure of 20-30 lb./sq. in., to the cutting head. The hardness of the material may be gauged from the fact that the life of the cutter head between regrinds was of the order of 6-ft. A further unit which was cleaned during this time was the condenser which completes the cooling of the overhead vapours from the fractionating column after most of the heat has been extracted in the vapour/tar heat-exchanger which heats the tar direct from the pumps. After passing from the condenser, water is separated from the product, part of which is pumped back to the top of the fractionating column and the remainder passed to the product storage. The condenser contains 1,000 tubes of $\frac{5}{8}$-in. i.d., these being 14-ft. long. The deposit in this case was a carbon sulphate scale, etc., which was removed with a "Lagonda" series-600 motor and cutter head. (*Consolidated Pneumatic Tool Co. Ltd., 232, Dawes Road, London, S.W.6.*)

New air filter regulator

A new Mason Neilan air filter regulator set (No. 77) comprises a large-capacity dripwell, porous ceramic cartridge-type filter, accurate pressure-reducing valve and safety-relief valve, all in one compact light-

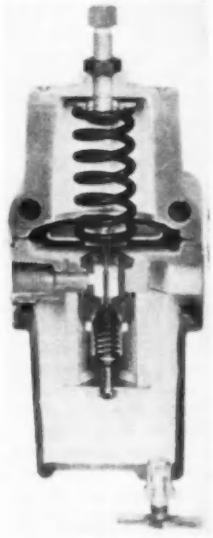


Fig. 4. A cut-away view of the new Mason Neilan No. 77 air-filter regulator set. (Crosby Valve & Engineering Co. Ltd.)

weight unit. The body is of die-cast aluminium with two mounting bolt holes. An outlet pressure gauge can be supplied, and if necessary the outlet connection can be orientated in three alternative positions. Elimination of alignment problems has resulted in a remarkably flat pressure/flow curve over a very wide range. The No. 77 air filter regulator set can be supplied with or without outlet and/or inlet pressure gauges. The maximum inlet pressure is 250 lb./sq. in.; reducing pressure range is 5-40 lb./sq. in.; weight $2\frac{1}{4}$-lb.; and overall height $8\frac{3}{4}$-in. (*Crosby Valve & Engineering Co. Ltd., Crosby Works, Ealing Road, Wembley, Middlesex.*)

Rust prevention

A method of preventing rust formation on the inside of water tanks of 100 to 1,500-gal. capacity has been evolved by the manufacturers of Metalife liquid metals. In this case, the Metalife has been cast in a solid form, so as to form an anode in a cathodic protection system. The solid Metalife anodic metal unit is easily installed, and the tank need not be emptied or put out of action. Once installed, the unit will give 8-12 years' service depending on the exact size of the tank and the type of water, and needs no further attention. Metal below the water-line will be protected, it is claimed, even if the water is so hot that coatings and galvanised-iron break down. Any rust that has already formed in the tank will be removed. (*Southern Metalife Limited, Station Square, Harrogate, Yorkshire.*)

Fully-automatic drainage pump

The Sumpette, a new self-contained and fully-automatic drainage pump for use in cellars and sumps having a maximum water depth of 2-ft. 6-in., has been developed by Holden & Brooke Limited. The makers claim that the pump is ideal for use in buildings where surplus water is lying below the level of service drains. Boiler house basements are typical of the numerous situations where the Sumpette may be employed to advantage. The unit is claimed to be economical to operate and, being portable, can be applied readily to deal with flooding emergencies due to bursts or stopped drains. Compact and easy-to-handle, the unit is made ready for operation simply by being electrically connected and fitted with a discharge pipe. The standard unit consists of a centrifugal pump and a totally-enclosed vertically-mounted 1/3 h.p. single-phase 230/250 V electric motor. A float-operated switch is embodied enabling the Sumpette to be left unattended. The pump may be operated without a starter, a thermal trip being incorporated in the motor. The following capacities, in the ratio of gal./min. to head in feet, can be achieved: 5/32, 10/30, 15/26, 20/21, 25/15, and 30/10. Long life and ease of maintenance are other advantages claimed for this new drainage unit. Neither of the two pump bearings requires lubrication and motor bearings need only be repacked with grease at two-yearly intervals. (*Holden & Brooke Limited, Sirius Works, Manchester, 12.*)

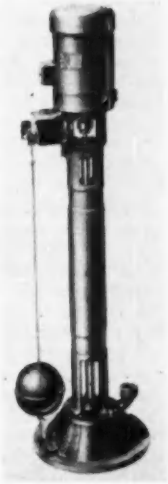


Fig. 5. The "Sumpette," self-contained and fully-automatic drainage pump. (Holden & Brooke Ltd.)

New float switch

A new float switch has been developed by Megator Pumps and Compressors Limited. The whole unit, comprising switch, float gear and counterweight, forms a single assembly for mounting. It requires only a small amount of head-room as it can be mounted near the upper water level and still provide for a large rise and fall. This is due to the original design of the float gear, on which patents are pending. A flat nylon belt is used instead of the usual wire rope and this allows the actuating stops or fingers that engage the switch trip lever to be mounted on the upper side of the belt, and to pass over the pulleys in operation. The unit is of robust construction and the switch and pulleys are protected by a strong welded steel cover. A B.S.A. "Acme" "Snap-lock" switch is utilised, and this may be of Buxton certified type for Groups I, II and III gases, or with normal water- and dust-proof enclosure. A safety locking pin is built-in, to prevent accidental energising of the circuit during maintenance. Pulleys are bronze, mounted on "Fluon"-impregnated bushes. A 20-ft. nylon belt is supplied as standard, punched at 3-in. intervals for easy adjustment of the switch actuating fingers which determine the operating levels. The float is corrosion- and puncture-proof, being made of expanded

polystyrene and containing many millions of separate water-tight air cells. It is encased in glass fibre for protection. The electrical specification allows for a single-pole switch, with silver contacts, rated at 10-amp., 440-volts, a.c. The flame-proof version has single-entry sealing chamber, and gland for armoured cable. The weather-proof switch is tapped for ¾-in. conduit entry. The overall dimensions of the new switch are length 18-in., depth 6-in. and height 13-in. (*Megator Pumps and Compressors Limited*, 43, *Berkeley Square*, *London*, *W.*1.)

A new range of brake motors

Newman Industries Limited are to introduce a range of electro-magnetic disc brakes suitable for building into any of their fractional horsepower and industrial three-phase motors (drip-proof or totally-enclosed) up to 15-h.p. The range of brakes will have retarding torques from 2.9 lb./ft. to 144 lb./ft. More important, perhaps, to users, will be the fact that a range of retarding torques will be available for each horsepower/frame-size of motor so that, within limits, the retarding torque can be matched to the requirement of the application rather than the speed or horsepower of the motor. Several brake units will be introduced during the year so that eventually the full torque range of 2.9 to 144 lb./ft. will be covered. The first unit, now in production, has a retarding torque range of 5.7 to 21 lb./ft. and the torque can be varied between these limits by a simple adjustment to the compression of the brake springs. The brakes are of the fail-to-safety type and operate direct from a 3-phase supply. This means that if for any reason the supply to the motor is cut off, the brake is automatically applied. However, in order to provide for those occasions when it may be necessary to make adjustments (for example, to machine tool drives) with the power switched off, there is a means of releasing the brake manually. The brake is protected by a cover through which the manual release screws project for ease of access. The brake itself has low inertia and is powerful and efficient for its size, and fits neatly on to a special non-drive end bracket on the motor and occupies very little space. An indication of the power for size of the brake unit may be gained from the fact that a brake motor of 3-h.p., 1,460 r.p.m., with a maximum retarding torque of 14½ lb./ft. is only 4 in. longer than an ordinary motor of the same rating. The machine tool and hoist industries are regarded as the chief fields of application for these new Newman brake motors, but they are, of course, suitable for a variety of other applications. (*Newman Industries Limited*, *Yate*, *Bristol.*)

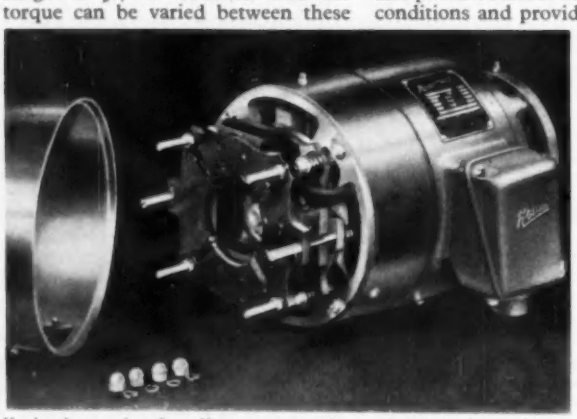


Fig. 6. A model from the Newman range of electro-magnetic disc brakes. (Newman Industries Ltd.)

New power source for Sigma welding

Quasi-Arc Limited have added a new constant potential rectifier to their comprehensive range of welding plant. Known as the MRF.600L, this machine provides a truly flat volt/ampere characteristic over its entire working range; it also compensates instantaneously for fluctuations in the mains supply voltage, so that the welding output is always maintained at a pre-set value. These features are made possible by the use of a magnetic amplifier controlled circuit (patent applied for) which also permits remote control of welding conditions and provides a high open-circuit voltage for easy arc initiation. The MRF.600L constant potential rectifier combines simplicity of operation with the optimum characteristics for SIGMA (inert gas shielded metallic arc) and other self-adjusting arc processes. Arc voltage is continuously variable between 20 and 38 volts and the welding current range is 200-600 amperes. (*Quasi-Arc Limited*, *Bilston*, *Staffs.*)

Electro-pneumatic rotary actuator

A rotary actuator available from Kinetrol Limited, has been designed to turn valves, flaps, cocks, etc., through a right-angle and back again in response to an electric signal. In cases where solenoid valves are unreliable and of insufficient power this compact and inexpensive actuator will provide a strong and positive action, working on an input air pressure of 80-100 lb./sq. in. It will tolerate a temperature of 200 deg. C., the materials will not corrode, and a small integral filter prevents the ingress of dirt when connecting up. The single rotary-vane piston design has resulted in a small overall size, and the bolting flange is readily adaptable to a variety of requirements. (*Kinetrol Limited*, *Trading Estate*, *Farnham*, *Surrey.*)

Fig. 7. The new electro-pneumatic rotary actuator for valves, flaps, cocks, etc. (Kinetrol Ltd.)

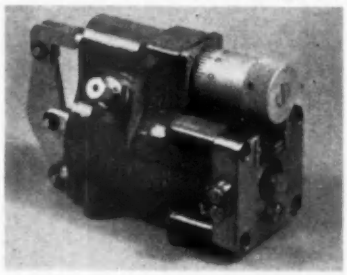
Transistorised conductivity bridge

A new portable, transistorised conductivity bridge (type—BCI) has recently been made available by A. M. Lock & Co. Ltd. It is of compact dimensions, weighs 7 lb., and is supplied complete with a dip-type conductivity cell as standard, while a laboratory flow cell or Hamburger cell are available. The a.c. measuring bridge is energised at a low potential by a 1,500 c/s transistor oscillator, this high frequency being used to overcome inaccuracies which would otherwise occur at high solution conductivities. In use, bridge balance is shown by maximum deflection of the indicator meter. The conductivity of the solution is then read from the large calibrated dial. By using this null-point method, variations in battery voltage or transistor characteristics do not affect the accuracy of measurement. The instru-

ment covers a wide measuring range, 0.5 micro-mhos to 1 × 10^6 micro-mhos in six ranges which are selected by the range switch. The bridge is suitable for use with most types of conductivity cell. If the cell has a constant other than unity, the actual solution conductivity is obtained by multiplying the bridge reading by the cell constant. Manual temperature compensation over the range 5-35 deg. C. is provided on ranges 2 and 3 at the rate of 2 per cent. per deg. C. This correction factor covers certain condensates and unprocessed waters, and most aqueous solutions with conductivity values in the range 5-1,000 micro-mhos. On other ranges the temperature compensator is not connected because the correction necessary varies according to the composition and concentration of the electrolyte. A built-in variable capacitor is provided to balance out cell and cable capacitance which would otherwise give a flat balance point. (*A. M. Lock & Co. Ltd., Prudential Buildings, 79, Union Street, Oldham, Lancs.*)

New metering pumps

A new series of directly-controlled metering pumps for general chemical applications, with capacities from 0-1½ to 180 gal./hr., has been introduced by the Kontak Manufacturing Co. Ltd. The Kontak metering pump



consists of a hermetically-sealed controlled displacement diaphragm pump called a "metering head" together with a motorised reciprocating oil pump, the function of which is to provide a remote hydraulic drive to the metering head. This is known as an "actuating pump." Where the remotely-controlled pumps are required for nuclear applications, an additional component known as a "regulator" is used to control the metering head displacement. However, with the new series of directly controlled pumps, the regulation control and indication is incorporated in the metering head itself. Extreme accuracy is put forward by the company as one of the major advantages of the pump. They claim an accuracy of less than ± 2 per cent. within specified conditions and ± ½ per cent. on repeatability under fixed conditions. Among other advantages claimed for the remote actuated pump are its ability to handle abrasive slurries and to run "stalled" indefinitely without damage, when operating against a blocked system. A complete hermetic seal between the pumped medium and ambient atmosphere, or actuating and control liquid, ensures freedom from contamination in either direction. Of particular importance is that multiple installations may also be operated with independent control for proportionate mixing from one actuating pump. Unskilled personnel may easily demount and refit the contact head without stopping the actuating part. The pump, which is self-priming, not only handles highly corrosive and toxic materials, but also gives an appreciable suction lift and delivery pressure. Pumps with 2-ml. and 15-ml./stroke displacement are available at present, but other types providing 5-litres a minute and up to 20-litres a minute are already under consideration. The 2-ml. micro-pump has a maximum delivery pressure of approx. 750 lb./sq. in. and a maximum suction lift of 15-ft. at 27 strokes/min. (*The Kontak Manufacturing Co. Ltd., Belton Park, Londonthorpe Road, Grantham, Lincs.*)

Fig. 8 (left). One of the range of remote regulators used in conjunction with the Kontak metering pumps. (Kontak Manufacturing Co. Ltd.)

New gauge tester

A new dead-weight pressure-gauge tester of entirely new design—the "Ranger"—for pressure readings between 10 and 8,000 lb./sq. in., and with an accuracy within 0.03 per cent., is the latest addition to the well-known series of pressure gauge testers, manufactured by Budenberg Gauge Co. Ltd. This series covers a range of pressures from 2 to 100,000 lb./sq. in. A patented priming pump combined with the oil reservoir quickly fills the system and applies an initial pressure up to 150 lb./sq. in. Pressure can be rapidly increased by a few turns of the main screw press, a hard-wearing unit fitted with a ball thrust and ground thread screw. Operation of the tester is simplified by the provision of a patented dual piston unit, with piston sizes of 1/8 and 1/80-sq. in. for low and high-pressure ranges respectively. The changeover from one range to the other is made automatically as pressure is increased, or decreased, by the screw press. A ratio of 10 : 1 can be obtained without changing the weights, thus enabling a pressure-gauge to be checked at both ends of the scale with a minimum of effort. Adaptors for all common types of standard and flush-mounting gauges, and other accessories, including pointer remover, punch and spanners, can be supplied. (*Budenberg Gauge Co. Ltd., Broadheath, Manchester.*)

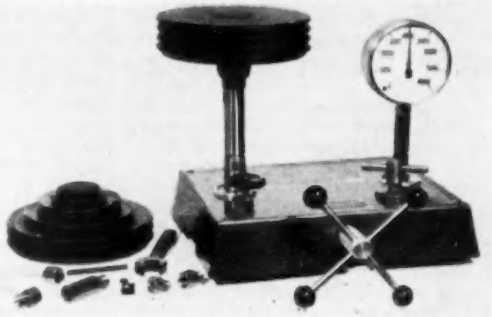


Fig. 9 (right). The new "Ranger" pressure gauge tester for readings between 10 and 8,000 lb./sq. in. (Budenberg Gauge Co. Ltd.)

Air velocity indicators

Shandon Scientific Co. Ltd. recently announced the introduction in this country of two new low-priced air velocity meters. They are respectively the Florite, a bridled-vane anemometer, and the Floret, a small pocket indicator. The former unit is a circular instrument with a die-cast housing, 4-in. dia. and 1¾-in. deep. The rotating peripheral scale, 8-in. long, gives direct readings in ft./min. or miles/hr. No charts, calculations or other aids are needed. Two scale ranges are available—0-1,000 ft./min. and 0-3,000 ft./min., the latter scale also bearing graduations in m.p.h. The readings are automatically averaged over an area 3-in. in dia. and accuracy is guaranteed within 2 per cent. of full-scale reading. A zero adjustment is provided. In operation, the Florite is simply held to the air flow and the reading taken. The rotor is magnetically damped to level out insignificant variations in velocity and to bring the scale rapidly to rest. A scale lock, released by a spring-loaded trigger, enables readings to be locked on the scale. Two models are available—Model MRF for normal use, and Model MDL fitted with a special scoop for measuring air flow from square or circular ceiling diffusers or louvres. The

Floret is a simple, pocket instrument providing instant direct readings on a 2¼-in. long sector-scale graduated in equal-sized divisions from 0-1,000 ft./min. It is entirely self-contained and requires no hose, probe or other auxiliary fittings. It operates in any position on the deflecting vane principle; the air entering through a small hole in the base of the moulded plastic case. A simple positive zero adjustment is provided. Overall dimensions are 4⅝-in. by 2⅛-in. by 1-in. (*Shandon Scientific Co. Ltd., 6, Cromwell Place, London, S.W.7.*)

New temperature controller

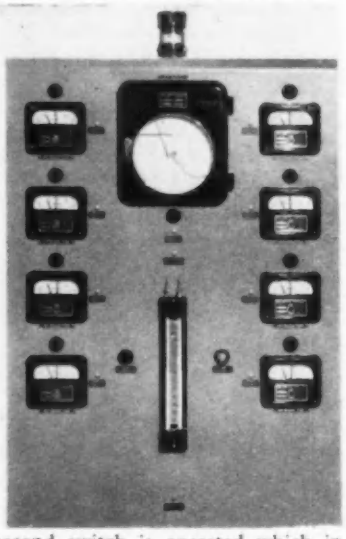
Co-operation between United Steels Limited and Winston Electronics Limited has resulted in the commercial production of what is claimed to be an extremely accurate temperature controller of robust construction. The Winston-United Steels temperature controller (type M.226) is the result of the research work on the problem of the critical temperature control of furnaces used in creep testing alloy steels, and is available for any desired range up to the limits of a platinum thermometer, i.e., 1,200 deg. C. A direct calibrated range of 1,000 deg. C. in ½ deg. C. steps is provided. The direct calibration of operating temperatures is possible through the use of improved multi-turn potentiometers. The furnace switching relay has no other circuit function to perform, and so avoids the critical adjustment of a normally troublesome component. The control of oil or gas furnaces is achieved by using a suitable magnetic valve. A mercury or vacuum switch may be fitted where greater current capacity is required. All the components are easily accessible for replacement. The circuit incorporated comprises a platinum resistance thermometer formed into an a.c. powered Wheatstone bridge, the preset arm of which consists of a 1,000 ohm potentiometer graded in 4,000 steps, each being 0.25 deg. C. The out-of-balance voltage from the bridge is amplified by a two-stage amplifier giving a gain of approximately 2,000. The degree of out of balance (i.e., temperature error) is displayed by a "magic eye" indicator, having two degrees of sensitivity. The amplified output is also fed to a phase sensitive bridge, which gives a positive or negative output according to whether the furnace temperature is lower or higher than the correct setting. This output is amplified 10 times by the d.c. amplifier and then applied to one section of the relay controlling the furnace relay. A time interval generator provides switching cycles of, normally, 30 sec. to the other section of the relay control, which is so connected that the first section conducts, thus energising the relay only when the control signal from the thermometer is more positive than the signal from the time interval generator. When the furnace is at the correct temperature, the relay is energised for one-half of the time cycle. The switching of the furnace relay is used to alter the furnace current between two values chosen to match the furnace characteristics. (*Winston Electronics Limited, Shepperton, Middlesex.*)

Fig. 10 (left). The Winston-United Steels temperature controller, available for any desired range up to 1,200 deg. C. (Winston Electronics Ltd.)

Fig. 11 (right). Control cabinet associated with the Accurate Recording system of ventilating-fan protection. (Accurate Recording Instrument Co.)

Ventilating-fan protection

The Accurate Recording Instrument Company have developed a system of ventilating-fan protection applicable to the coal-mining industry. It is designed to prevent breakdowns in the event of bearings becoming overheated, loss of air in the pit workings due to low fan-speeds, or roof falls in the workings. In addition, a device has been developed which will cause an alarm to sound should a Vee rope (in cases where these are used) either start to wear or break. Oil temperature and pressure protection is supplied where gear boxes are used to transmit the drive from the prime-mover. The pressurestat will cause the alarm circuit to function in the event of low-pressure in the gearbox lubrication system. The principle of the temperature measurement of the bearings is the firm's well-known liquid expansion system, as applied to their indicating thermostat. A rise in temperature at a bearing measuring point (normally in the oil-reservoir) causes a bellows to operate a micro-switch (capable of 10-amps at 250-volts), which, in turn, closes a visual lamp and audible alarm circuit. The audible alarm may be silenced, but a flashing lamp is immediately switched on, showing that alarm conditions exist. This lamp and that associated with the bearing will remain alight until action has been taken to restore conditions to normal. The pre-set point at which the alarms come into circuit is infinitely variable over the whole of the instrument scale range, by means of a special key, and is normally set some 5-10 deg. above the normal working temperature of the bearing. If, however, the temperature of the bearing should continue to rise, a second switch is operated which in turn will cut the mains supply to the fan motor, thus stopping the fan and avoiding further damage. The instrument is fitted with a third micro-switch which is operated in the event of the instrument becoming unserviceable through any known cause, thereby providing a "fail safe" system. The whole of the thermometry is of the "fully-compensated" type, and is not affected by changes of ambient temperature on long lengths of capillary, and instrument head. The draught-gauge recorder measuring the air-pressure in the pit is fitted with high and low contacts which are variable and normally set at some point lower and higher than the normal. Should



a variable condition occur, one of these contacts will cause a visual and audible alarm to be made as in the case of the bearing temperature. The whole of the visual and audible alarms may be transmitted to a small remote supervisory panel up to a considerable distance away, together with precise readings on a 6-in. indicator of the w.g. suction conditions. This means that the more important functions of the system may be located at a remote point and can be under the supervision of persons doing another job. The fan belt alarm operates into the common visual and audible alarm circuit, and is designed to bring to the notice of the persons responsible, the fact that a belt is about to break or has broken. The equipment is housed in sheet steel panels for floor mounting, and is self-contained. A feature of the equipment is, that the important measuring instruments are mechanical, and do not depend on mains electrical supply for correct operation, they are very sensitive to small changes of temperature, and are of very robust construction. (*The Accurate Recording Instrument Company, Windsor Avenue, Merton, S.W.19.*)

Mr. F. H. S. Brown, C.B.E., B.Sc., M.I.Mech.E., M.I.E.E., has been appointed deputy chairman of the Central Electricity Generating Board in succession to **Mr. C. R. King,** C.B.E., whose appointment as chairman of the Electricity Council with effect from September 1st was recently announced. Mr. Brown has been a full-time member of the board since its formation two years ago, having previously been chief engineer of the Central Electricity Authority. He was educated at King Edward School, Birmingham, and Birmingham University, and after service with the Birmingham and Liverpool Electricity Supply Departments became generation engineer (construction) and subsequently chief generation engineer of the British Electricity Authority's Merseyside and North Wales Division.

* * *

Mr. A. L. Ayton, F.C.I.S., retired on August 31st, from his position as secretary of Keith Blackman Limited, and the Blackman Export Co. Ltd., after 50 years' service with the company. He remains a director of both companies. **Mr. E. W. A. Richards,** F.C.I.S., assistant secretary, has been appointed secretary of both companies, and **Mr. A. W. Milborrow,** chief accountant.

* * *

Mr. W. E. A. Redfearn, director, English Steel Corporation Limited, deputy managing director, English Steel Forge & Engineering Corporation Limited, and director, English Steel Rolling Mills Corporation Limited, has been appointed chairman of the National Forgemasters' Association in succession to the late **Sir Frederick Pickworth.**

* * *

Four new appointments are announced by A.E.I. Heavy Plant Division; these are as follows:—**Mr. E. C. Barwick,** B.Sc.(Eng.), M.I.E.E.—manager, Large Electrical Machine Engineering (Rugby), **Mr. E. E. A. Grace,** B.Sc. (Eng.), A.M.I.E.E.—manager, Medium Electrical Machine sales. **Mr. K. F. Raby,** M.A. (Cantab.), A.M.I.E.E.—manager, Medium Electrical Machine engineering, **Mr. W. H. Hunt**—superintendent, Medium Electrical Machines Dept.

* * *

Houseman & Thompson Limited the well-known water-treatment consultants, chemical manufacturers and chemical engineers, have transferred their head office from Newcastle upon Tyne, to The Priory, Burnham, Bucks. (Telephone No. Burnham 1704 six lines.) Control of the company's Northern Regional business is now centralised at the existing premises, Smeaton Street, Willington Quay, Willington-on-Tyne.

Mr. Maurice Tattersfield, A.C.A., has been elected to the board of The George Cohen 600 Group Limited, following his appointment as financial controller of the group last year. His previous posts include those of director and secretary of Electro Hydraulics of Warrington, and of Conveyancer Fork Trucks Limited, director of the Brush Group of Companies, and managing director of Brush Electrical Engineering Limited.

* * *

Mr. G. B. Perry has been appointed managing director of Axia Fans Limited, a member of the Hall-Thermotank group of companies. He has also been appointed a director of Vent-Axia Limited, and will retain his seat on the board of Thermotank Limited, with which company he formerly held the executive posts of director, Engineering Division, and general manager of its International Products Division. Mr. Perry, who shortly will take up his new duties in London, has, since 1939, been at Thermotank headquarters in Glasgow, and as a result of Mr. Perry's appointment, **Mr. R. C. Adie** has been promoted to be general manager of Thermotank's International Products Division, and **Mr. H. J. Watson** is now general manager of the Engineering Division.

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Mr. G. A. S. Nairn, M.B.E., F.R.S.A., of Bromborough, Cheshire, has been reappointed as a part-time member of the C.E.G.B.

* * *

The **Ward Group of Companies,** Albion Works, Sheffield, 4, have issued a very attractive brochure (G5 1) dealing with their products and services. The 68-page brochure is well illustrated, and lists the many industries for which the very comprehensive range of Ward products and services are available.

* * *

Sturtevant Engineering Co. Ltd. have issued a new publication (No. 6001) entitled "Cathodic Protection." In the November, 1958, issue of this journal we made mention of the fact that the Sturtevant Engineering Co. Ltd. had established a Cathodic Protection Department. The new publication gives details of the activities of this department, and also gives details of cathodic protection, knowledge of which, the Sturtevant Company has built-up following extensive experience of electrode techniques, potential fields and ionic processes. Sturtevant have augmented this engineering knowledge, by recruiting some of the leading cathodic protection engineers, and reinforcing this team with considerable research and development facilities.

Mr. G. C. Dale, B.Sc., has been appointed physicist deputy in the Nuclear Health and Safety Department of the Central Electricity Generating Board. Mr. Dale entered the Ministry of Supply in 1959, and joined the department which subsequently became the Health Physics Division of the Atomic Weapons Research Establishment, Aldermaston, which he now leaves to take up his appointment with the Generating Board.

* * *

Non-metallic "Morganite" carbon vanes for rotary air- or gas-compressors and liquid pumps are chemically-inert and resistant to attack by many chemicals, including most acids, alkalis and corrosive salts. They do not impart odour or taste. Self-lubricating properties enable them to operate in petrol, water or other fluids where the lubricating value is low; or in inaccessible positions. The vanes are unaffected by temperature, and pump pressures may range from 30 lb./sq. in. down to high vacuum conditions, with peripheral speeds up to 2,000-ft./min. Further details are contained in publication SD 69 available from: **The Morgan Crucible Co. Ltd.,** Battersea Church Road, London, S.W.1.

* * *

We have received from **Crofts (Engineers) Limited,** Bradford, 3, two new leaflets, viz.—Publication No. 5950, which describes "Ritespeed" geared motors available from 1 to 20 h.p. and incorporating Brush industrial-type, squirrel-cage, totally-enclosed, fan-cooled, a.c. motors, and Publication 1-5814, which deals with Crofts free space hydraulic couplings and drives. These latter are available from stock up to 100-h.p. at 1,450 r.p.m., while also being obtainable for up to 700-h.p.

* * *

Manufacture by the **British Thomson-Houston Co. Ltd.** of the propulsion equipment for the 45,000-ton turbo-electric ship *Canberra,* which is being built by Harland and Wolff Limited, Belfast, for the P. and O. Steam Navigation Company, is well advanced. The 42,500-s.h.p., 147-r.p.m., double-unit, closed-air circuit, port propulsion motor is being dismantled for shipment, after official tests in the Rugby Works of the British Thomson-Houston Co. Ltd.—Management Company of the A.E.I. Heavy Plant Division, who are handling the complete contract for the propulsion equipment.

* * *

The address of the Bristol branch office of **The English Electric Company** is now Equity and Law Building, 36/38, Baldwin Street, Bristol, 1. The tel. number remains Bristol 27304.

OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

Feedwater treatment

For the reduction of silica in boiler make-up water supplies, the Scovill Manufacturing Company, of Waterbury, Conn., U.S.A., now use a new ion-exchange method known as the "Desilicizer." The basis of the system is the ability of strong base anion resins to split the salts in soft water. It was then determined that this salt-splitting capacity, when used in a hydroxyl cycle (OH active form), was capable of efficiently removing silica from soft water, without demineralising the water. Numerous small units have been installed and operated, but the Scovill plant is the first large industrial plant utilising the process. The steam generator for which the new plant was installed is a 100,000 lb./hr., 660 lb./sq. in., 750 deg. F., controlled-circulation unit, and originally two methods of silica reduction were considered, i.e., hot-process softening, and demineralising. It was thought that the hot-process would be very costly from an installation standpoint, in that major foundation work and feedwater piping changes would be required. Existing treatment plant at the site would be useless. A demineraliser appeared to be the logical choice, but this, too, was a costly investment, because rubber-lined equipment was required, and the sodium-zeolite units would have to be considered surplus. The "Desilicizer," which would cost about half the price of a demineraliser required for this application, would be cheaper to install, and would utilise all the existing treatment equipment. Also, it would operate on an economical regenerant, and was considered as the most logical system to install. Space was at a premium, and the "Desilicizer" was tailored into a very limited area, utilising numerous headroom- and space-saving designs in the exchangers. The capacity selected was 340 gal./min. Since the existing sodium-zeolite softeners were capable of handling this flow (plus the rinse load of 140 gal./min. for one "Desilicizer"), they were left intact, and investment in new zeolite softeners was not required. This further enhanced the desirability of the "Desilicizer" installation. There are three "Desilicizer" exchangers, each 5-ft. 6-in. — 6-ft. and designed for operating at 75 lb./sq. in. These shells are of unlined steel construction, and are complete with steel internal distributors, including special underdrain design. Each unit contains 60-cu. ft. of Cochranex AL, a type-1, non-porous strongly-basic anion-exchanger resin, operating on the OH cycle. The valves are 3-in. unlined Cochrane "Hydromatic" single-control valves, with integral automatic backwash and rinse regulators, which function accurately, regardless of line-pressure variations. Due to the simplicity of operation of the "Hydromatic" valve compared to a valve nest, a manually-operated plant was selected. Length of run is determined by periodic silica tests and, in addition, each unit has a 2-in. totalising meter with alarm contacts. Regeneration is effected with warm caustic from an unlined-steel measuring tank containing electric heaters, and associated temperature controls. Part of this caustic is recovered for use in the next regeneration, and sent to a reclaim system consisting of a holding tank, electric heaters, controls, flow-indicators, and reclaim injection pump. Desilicised water (which now contains primarily sodium hydroxide, and has a pH of 10-11) is partially neutralised with a small amount of sulphuric acid, to reduce the pH to about 9.5. Acid is line-fed with a pneumatically-controlled pump which feeds proportional to flow. A pH recorder has been installed for information and record purposes. Caustic feed to the boiler is no longer needed. As shown in Fig. 1, the make-up-water passes through a blow-down heat-exchanger, and on to a feed-water-heater. The process is capable of reducing silica to less than 1 ppm, and in addition, it will eliminate HCO_3 and CO_3 alkalinity, thus keeping the CO_2 content of the boiler steam at very low values. It is especially economical and practical for treatment of low-solids waters (less than 100 ppm), where silica removal is required for boiler feed-water, in the medium pressure ranges (450 to 1,100 lb./sq. in.). The use of unlined-shells and steel piping, plus the simplicity of operation and low maintenance of this process, are advantages. Further, a "Desilicizer" installation can be added directly to existing sodium-zeolite softeners, should the boiler-pressures be increased, or silica-removal become necessary. (*Power Engineering*, Vol. 63, No. 8, pp. 93/94.)

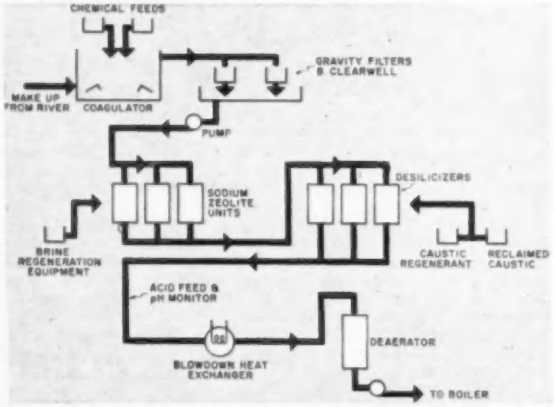


Fig. 1. Diagrammatic arrangement of installation of Desilicizers, in series with sodium zeolite softeners. Water then passes to the boiler via an acid-feeder, heat-exchanger and de-aerator.

Atomic control of cooling tower water

Experience has been gained with an automatic control system for cooling tower water in five plants controlled by the Southwestern Pub-

lic Service Company of America. These plants contain a total of seven boiler/turbine units, ranging in size from 20 to 100-MW. The system has been designed to (1) control make-up water treatment to minimise scale and corrosion; (2) hold the concentration of dissolved solids within narrow limits; and (3) maintain correct cooling-tower basin level under all load conditions. Control is based on the quantity of water evaporated in the cooling tower and the condenser heat load. Cooling water absorbs about 950 B.Th.U. to condense 1 lb. of steam, and the cooling tower evaporates about 1 lb. of water to release this heat to atmosphere. So the ratio between condenser hotwell flow and the water evaporated in the cooling tower is pound for pound when the hotwell flow is directly proportional to the condenser heat load. A flowmeter in the condensate pump discharge line is the primary control element. If the hotwell receives other flows, such as boiler makeup, the meter is compensated to indicate the correct amount of condensed steam. Adding 1 lb. of makeup to the cooling-tower basin for each pound of condensed steam results in a constant water level. But evaporation rapidly increases the concentration of dissolved minerals and the cooling water soon becomes too contaminated to use. The suggested remedy is to bleed water from the basin and replace it with makeup. Ratio of blowdown to evaporation losses is calculated from the raw-water analysis. Assuming that the total dissolved solids equals 200 p.p.m., and that with proper treatment 600 p.p.m. dissolved solids can be tolerated without scale formation, the number of concentrations is three. The cooling system is then bled in ratio of 1/3 lb. concentrated circulating water to each 1 lb. of treated makeup. Total makeup added at any given instant equals the sum of evaporation losses plus blowdown and in this case is about 1 1/3 times the condensate flow. The flow diagram (Fig. 2) shows the basic control components; a condensate flowmeter furnishes an impulse to position the blowdown and makeup valves. Waste and makeup valves are positioned so waste flow is a fixed percentage of makeup flow under all heat loads; a makeup meter adjusts chemical feed in proportion to flow. The pH meter checks performance and is a helpful guide when the raw water varies in quality. A water-level instrument acts as an overriding control in the event of a system upset. Normally basin-water level is held within close limits by makeup and blowdown controls, but when these controls are inoperative the level-controller restores basin level to control point. Analysis of water costs at four plants using automatic controls was compared with costs at five stations employing manual operation. Significant differences were found. Water costs at the automatically controlled plants ranged from 1.0 to 1.7 cents per thousand gallons less than average costs at plants with manual operation and control. These savings represent an excellent return on a very nominal investment. Many plants are already equipped with some of the basic instruments. Water level and condensate flowmeters can often be adapted for automatic cooling-water control. (*Power*, Vol. 8, 103, No. 8, pp. 186/187.)

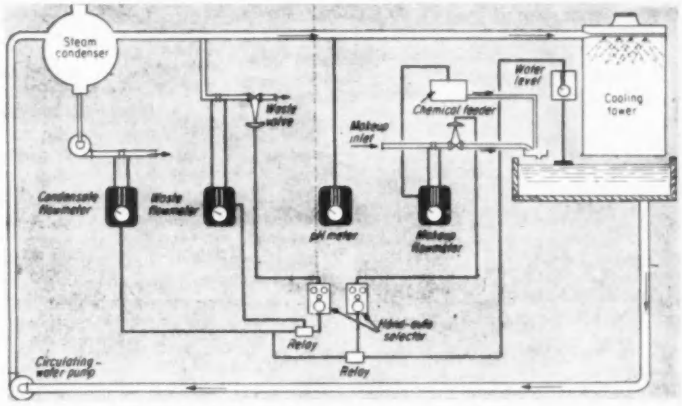


Fig. 2. The automatic cooling-water system utilises a condensate flow-meter to position make-up and blowdown control valves. Preset ratio of blowdown to make-up is maintained under all condenser heat loads. A flow meter on the make-up line adjusts the chemical feed.

A contract valued at over £1 million has been awarded to **Taylor Woodrow Construction Limited** by the Central Electricity Generating Board for a hydro-electric project at Cwm Rheidol, near Aberystwyth, Cardiganshire. The consulting engineers are Freeman, Fox & Partners in association with James Williamson & Partners. The work, which will take two years to complete, involves the construction of a 700-ft. long concrete gravity dam, the maximum height of which will be 40-ft.; the driving of a concrete-lined tunnel, 2,200-ft. long with a finished dia. of 9-ft. 6-in.; the sinking of a 25-ft. dia. concrete-lined surge shaft to a depth of 150-ft. and a 10-ft. dia. pressure shaft to a depth of a further 510-ft. The contract also includes the construction of a power station in which two 18-MW turbo-alternators will be installed. This contract is the fourth and last of the major civil engineering contracts of the Rheidol Hydro-Electric Project, the construction of which has been in progress for two years.

Details of a wide range of valves, fittings and tubes for all industries are contained in a new 30-page brochure published by **Markland Scowcroft Limited,** Bromley Cross, Nr. Bolton. Copies are available upon application to the company, who also manufacture tanks and steel fabrications, supply flame-cut steel blanks, and construct structural steelwork.

* * *

Eighty engineering students from 16 overseas countries were entertained recently at a reception in Marconi House by **The English Electric Co. Ltd.,** to mark the end of a summer vacation course spent with British firms. The students, who included a group of 22 from France, one from Poland, three from Turkey, as well as representatives of other European and Scandinavian countries, come on exchange visits organised by the International Association for the Exchange of Students for Technical Experience (I.A.E.S.T.E.). The guests were welcomed by Mr. E. R. L. Lewis, controller of education of The English Electric Group of Companies, and Mr. R. P. Tabb, the company's assistant director of engineering, spoke on current developments in the industry.

* * *

British Standard for methods of testing refractory materials

This nine-page addendum to B.S. 1902 : 1952 specifies an alternative method for the determination of silica in alumino-silicate and silica refractories. Other methods in the new publication deal with the measurement of:—size of refractory bricks and shapes, bulk density and warpage. The method for the determination of silica is particularly applicable when the determination of other constituents is not required. The addendum contains a full-page diagram of an apparatus for the measurement of warpage. Copies of this addendum may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Price 3s. (Postage will be charged extra to non-subscribers.)

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Boiler with gas recirculation

It is a primary object of this particular invention to reduce dry gas losses in a steam generator, but another important object is to improve combustion, and to control combustion temperature in the furnace by replacing, prior to combustion, the nitrogen in the combustion air with recirculated gaseous products of combustion. The outline arrangement (Fig. 1) shows a steam generator equipped with a furnace (4) fired with

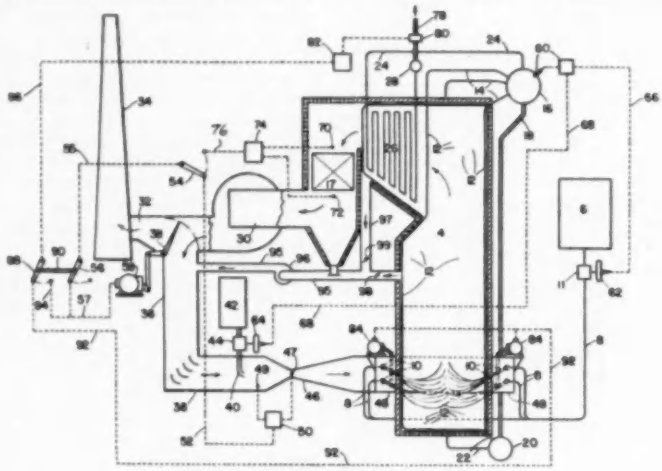
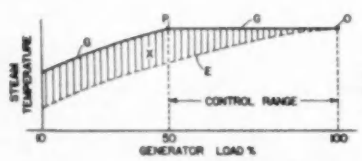


Fig. 1. British Patent No. 815,724.

fuel from a source (6) by way of fuel-pipe (8) and burners (10). A fuel valve (11) is provided in pipe-line (8) to control the amount of fuel thus burned. The products of combustion pass upwardly through the furnace (4) giving off heat to the furnace walls, roof and floor. Having given up a large amount of heat to the superheater (26), the gases pass over economiser (17) for final cooling and leave the steam-generating unit by way of induced-draft fan (30). Some of the cooled combustion gases are discharged into the atmosphere via duct (32) and stack (34). A large portion of the gases, however, is returned to the furnace by way of recirculating duct (36). Damper (38) serves to proportion the combustion gases between duct (32) and duct (36). According to the invention, oxygen of commercial purity, and largely free of nitrogen, is introduced into the recirculated gas stream such as by pipe (40) from a source (42). Valve (44) controls the amount of oxygen thus introduced. In the line illustration a venturi meter (46) or similar device is shown installed in the recirculated gas duct (36) at a point between the furnace (4) and the introduction of oxygen for the purpose of measuring the gas-flow entering the furnace. The recirculated gases having thus been enriched with oxygen, enter the furnace chamber (4) via burner windbox (48) in surrounding relation with the fuel ejected from burners (10), and in supporting combustion take the place of air customarily made use of for this purpose in conventional furnaces. By substituting recirculated gases for the nitrogen in the air, in accordance with the invention, the dry gas losses can be reduced considerably. Curve *E* in Fig. 2 shows the rise of the steam temperature in a conventional boiler from an intermediate load of 10 per cent. to a top load of 100 per cent. In a conventional boiler operating with a mixture of fuel and air, the steam temperature can be held constant within a load range of, for example, 50 per cent. and 100 per cent., at a temperature value indicated by curve (*G*). This can be accomplished by recirculating gases into the furnace within the above range. In this manner the temperature of the steam is increased from values indicated by curve (*E*) to values indicated by curve (*G*) by amounts represented by the cross-hatched area (*X*). In a steam generator designed and operating in accordance with this invention, however, the 50 per cent. control range can be increased considerably. By replacing the nitrogen content in the combustion air with recirculated gases, the percentage of these gases, which act as a diluent, can be reduced to a value below the percentage of nitrogen in air. In Fig. 2, point (*O*) represents the load at which gas recirculation begins with decreasing load. At this point in a conventional boiler, the percentage of the diluent (nitrogen) in the combustion air would be approximately 77 per cent. by weight. As the load decreases more diluent is added such as by recirculating gases until a practical lower limit is reached at point *P* or 50 per cent. load. In a steam generator operating in accordance with the invention and as shown in the graph Fig. 3, the point *O* of Fig. 2 can be placed at a lower load such as point *O'* at 65 per cent. load. In Fig. 3 broken line curve *F'* represents the steam temperature obtained without control and curve *G'* the controlled steam temperature. As the load decreases from point *O'*, gas is re-



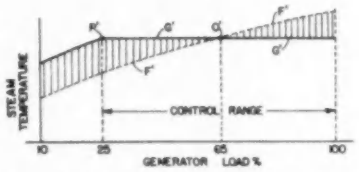
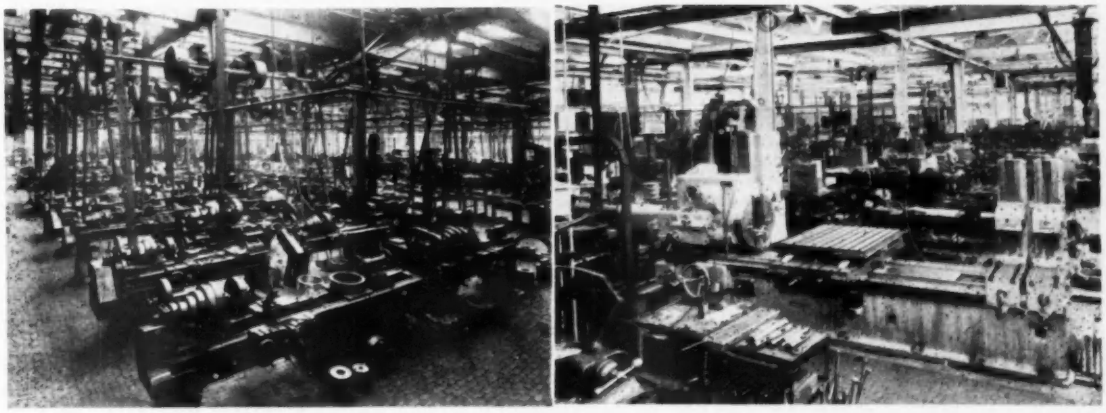


Fig. 2. (left). Fig. 3 (right). British Patent No. 815,724.

circulated in the same relative amounts as in the unit represented in Fig. 2 until point P' is reached, which is the lowest practical limit of gas recirculation. In a unit operating in accordance with the invention this point P' may coincide with the 25 per cent. load point which is considerably lower than that indicated by point P of Fig. 2. To maintain the steam temperature constant within the load range above point Q' in a steam boiler designed in accordance with the invention, the amount of recirculated gases is lowered still further, thereby increasing the heat absorption in the furnace and lowering the steam temperature as shown by curve F' to the desired value indicated by curve G'. It is thus seen that the steam temperature control range achieved by gas recirculation can be increased substantially as shown graphically in Fig. 3. *British Patent No.* 815,724 *issued to Combustion Engineering, Inc. Complete specification published July* 1*st*, 1959.

Modernisation of a Small Factory

The work of motorising the entire factory of the United States Metallic Packing Co. Ltd., at Bradford, was recently completed. Despite its name, the company is, as most of our readers already know, of British origin, and was formed in 1890 to take over the U.K. business of an American concern of the same name. The 2½-acre factory is equipped with its own foundry, and manufactures metallic packings for steam engines, centrifugal pumps, gas and diesel engine piston rods, steam traps, and pneumatic and hydraulic power cylinders which have a wide range of industrial and marine engineering applications. A particularly important sphere of the company's business is concerned with the mining industry, steel rolling mills, and marine requirements. Most of the plant in the factory is of the type of specialised machine tools associated with light engineering, but there is also a large amount of conventional machine tool equipment. The motorisation scheme was commenced during June, 1955, when cables were run from a 1,000-amp oil circuit-breaker to four main distribution points in the factory. (The power demand is of the order of 260 kVA.) At this time, the machinery was driven from line shafting using a Cole Marchent & Morley high- and low-pressure steam engine as prime mover. The machine drives were via conventional keyed pulleys with a "fast and loose" pulley and belt-shipping gear. Electrical services were supplied from two old belt-driven d.c. generators. Before deciding upon the h.p. of individual electrical drives, representative machines were fitted with a test motor and "on load" watt-meter readings taken by Crompton Parkinson engineers. Horse-power requirements based on this method of calculation proved to be 100 per cent. successful. Groups of the new motors—which vary in size from ½ h.p. fractional machines on small grinders, to 40 h.p. slip-ring machines for compressor drives—were bolted in position ready for change-over. The motors were positioned according to clearly defined production sections so that, when a change was made from machine pulley drive to motor vee-rope drive, the work involved was completed so quickly that normal production in the section was virtually uninterrupted. Due to the physical construction of a few of the older machine tools, direct motorisation was neither a practicable nor an economical proposition. In such cases, a part of the original line-shaft and belt drive is retained, and the motor is mounted overhead adjacent to the line-shaft pulley. Nearly 150 motors are now in use, comprising both squirrel-cage and slip-ring types, and they provide approximately 900 h.p. Load limitation is no longer a daily concern, as was previously the case with the 160 h.p. steam engine. An outstanding effect of the motorisation scheme appears to be the unprecedented flexibility of machine drives. This flexibility is most obvious outside normal working hours when only a few machines may be required. Also, about 15 per cent. of belt slip has been eliminated, and this gives a proportionate increase in tool efficiency since feeds and speeds are now nearer to the makers' specifications. Apart from the obvious visual improvements and better lighting conditions since the thick forest of belt drives has been removed, the amount of noise from the machinery is now very much reduced. At the moment, insufficient time and operating experience has elapsed since the electrification scheme was completed to compare the cost of the new scheme with that of the old. All the motors and cables used in this scheme were made and supplied by Crompton Parkinson Limited. The electrical contractors were Inman Joist & Co. Ltd., Bradford, and the mechanical installation was carried out by the United States Metallic Packing Co. Ltd.



Two views of the Bradford works of the United States Metallic Packing Co. Ltd., showing (left) before, and (right) after motorisation had been completed.

NOTES *Personal* AND *Industrial*

Sir Henry Jones, deputy-chairman of the Gas Council since February, 1952, has been appointed to succeed **Sir Harold Smith,** K.B.E., as chairman on January 1st, 1960. When the gas industry was nationalised ten years ago, Sir Henry became chairman of the East Midlands Gas Board where he remained until 1952, when he became deputy-chairman of the Gas Council. He is also a director of the National Industrial Fuel Efficiency Service, British Coke Export Sales Corporation, Benzole Producers Limited, and Association pour L'utilisation du Coke en Scandanavie. He received his knighthood in the 1960 New Year Honours List. Sir Henry Jones will be succeeded as deputy-chairman of the council by Mr. W. K. Hutchison, who has been chairman of the South Eastern Gas Board since its formation in 1948.

* * *

Powell Duffryn Limited have agreed with the newly-formed Mining Machinery Manufacturers' Export Association that the company will release **Mr. D. G. Hemmant,** the managing director of their international consultancy organisation, Powell Duffryn Technical Services Limited, for a period of up to one year from September 1st, to take up the appointment of acting director of the association. During Mr. Hemmant's absence, **Mr. R. Turner,** chief engineer of the company, will be acting managing director.

* * *

Captain R. A. Villiers, C.B.E., A.M.I.E.E., R.N. (Ret'd.), has been appointed director of The Scientific Instrument Manufacturers Association of Great Britain, Sima House, 20, Queen Anne Street, London, W.1.

* * *

Mr. R. F. Campbell, A.M.I.E.E., has been appointed generation engineer, Midlands Division, of the Central Electricity Generating Board, in succession to **Mr. H. Bancroft,** who has been transferred to the East Midlands Division. **Mr. T. Howard,** A.M.I.E.E., formerly deputy station superintendent at Hams Hall "B" power station, has been appointed station superintendent of Nechells "A" and "B" power stations.

* * *

Mr. S. E. Bolton has been appointed to a newly-created post of assistant general manager, export sales, for The English Electric Co. Ltd. Three new appointments have been made in the English Electric Company's export organisation: **Mr. J. F. Herbert** has been appointed general manager export sales; **Mr. S. E. Bolton,** assistant general manager export sales, and **Mr. S. W. J. Butler,** manager of a new overseas factories department.

* * *

Mr. W. Cusworth has been appointed a director of the Brightside Foundry and Engineering Co. Ltd.

The General Electric Co. Ltd. announces that **Mr. T. W. Heather** and **Mr. R. E. Robinson,** assistant managing directors, and **Sir Patrick Ashley Cooper,** a director, wish to retire in the present financial year. **Mr. A. L. G. Lindley** has been appointed vice-chairman and a managing director of the company.

* * *

Geo. Salter and Co. Ltd. announces that all products of the engineering divisions are now combined under one sales manager, **Mr. G. Rushton. Mr. W. A. Whitehouse** has been appointed sales controller (engineering divisions), and a new representative, **Mr. J. M. Hipkins,** has been appointed to take over the Birmingham, Warwick and Oxford areas. **Mr. Wm. M. Stewart** has been appointed technical manager for engineering products for Scotland and the Border counties.

* * *

The Indian Steelworks Construction Co. Ltd. announce with regret the resignation of **Brigadier M. H. Cox** from the post of resident director at Durgapur as from August 10th, 1959. Brigadier Cox, who has been with ISCON since the start of the Durgapur Steel Project, is being succeeded by **Mr. D. J. Bell,** who was with Stewarts and Lloyds Limited before being appointed to ISCON as general manager of the Durgapur Steel Project.

* * *

Mr. R. Yeoman, general manager for the Hodgkinson Group of Foundries, has been appointed to the board of the parent company, James Hodgkinson (Salford) Limited.

* * *

It is with regret that we record the sudden death in Paris recently of **Mr. L. K. Everitt,** a director of Edgar Allen & Co. Ltd., as general manager of the company's steel department. Mr. Everitt, son of the late Mr. C. K. Everitt, former chairman of the company, was born in Sheffield in 1902, and joined the company in 1924. Under Mr. Everitt's guidance, the first high-frequency melting furnace in the world for the manufacture of high-grade tool-steel was installed in 1927, and he became manager of the steel department in 1928. He was elected to the board in 1937.

* * *

A £750,000 contract for the construction of the superstructure at Willington "B" power station, near Derby, has been awarded by the Central Electricity Generating Board to **M. J. Gleeson (Contractors) Limited,** North Cheam, Surrey, following their completion of the £1¾-million foundation work. Work is to commence on the superstructure immediately, the project being due for completion by July 1st, 1962. Engineering consultants for the scheme are Ewbank and Partners Limited in association with Messrs. Farmer and Dark.

Dr. C. P. Haigh, B.Sc., Ph.D., F.Inst.P., has been appointed director of the Berkeley Nuclear Laboratories of the Central Electricity Generating Board. Dr. Haigh spent two years as assistant physicist in the electronics laboratory of Ferranti Limited, Hollinwood, Lancs., and in 1943 became the physicist at the research laboratories of Thorium Limited, Amersham, Bucks., where he stayed until 1949. From 1949 to 1956, as principal physicist at Barrow Hospital, Barrow Gurney, Bristol, he was engaged in the medical research aspects of nuclear physics. In 1956 Dr. Haigh joined the staff of the then Central Electricity Authority, as head of the physics section of the Nuclear Development Branch, the post he vacates to take up his present appointment.

* * *

Mr. R. W. Weekes, M.Inst.C.E., managing director, The Harland Engineering Co. Ltd., recently visited the Argentine, in connection with the completion of a contract worth approximately £1-million for the supply and erection of the complete mechanical and electrical equipment of four major pumping stations for the domestic water supply of the city of Buenos Aires. Mr. Weekes also met various ministers and government engineers to discuss projected public and industrial developments requiring centrifugal pumps, water turbines and their associated electrical rotating machinery of the specialist type manufactured by The Harland Engineering Co. Ltd.

* * *

Evershed and Vignoles Limited, manufacturers of instruments and electronic control equipment, announce the removal of their Scottish Area office into larger accommodation at 30, Rutland Square, Edinburgh, 1. The telephone number remains as before as Fountainbridge 3056.

* * *

After more than 25 years at Ingate Place, London, S.W.8, **Stream-Line Filters Limited** have moved to new premises at Henley Park, Guildford, the headquarters of the parent company, Vokes Limited.

* * *

James Gordon & Co. Ltd. are holding an exhibition of their products comprising instrument equipment and automatic controls for boiler plant, furnaces, heating installations, steam supplies, etc. The exhibition is being held at the Corporation Hotel, Middlesbrough on October 6th, 7th and 8th next, between 5.30 and 9.30 each evening. Members of the company's technical staff will be present to discuss any problems which visitors may have. Further particulars of the exhibition can, of course, be obtained from James Gordon & Co. Ltd., Dalston Gardens, Stanmore, Middx.

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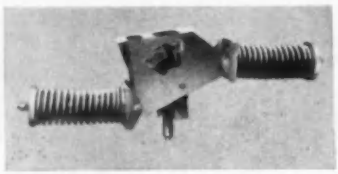

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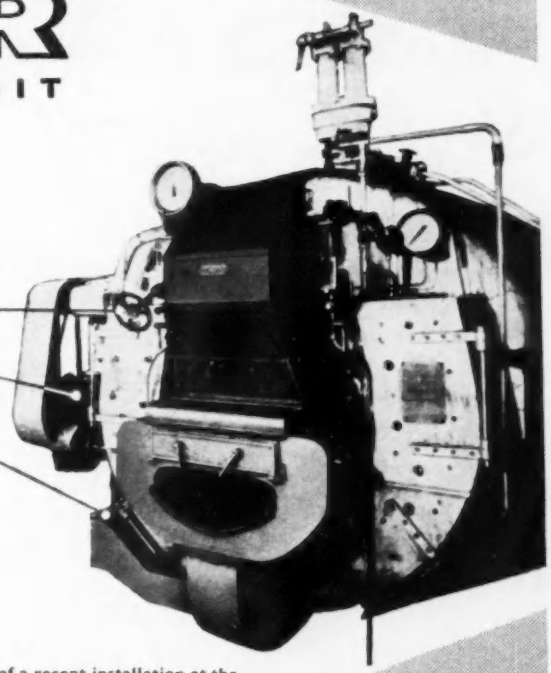

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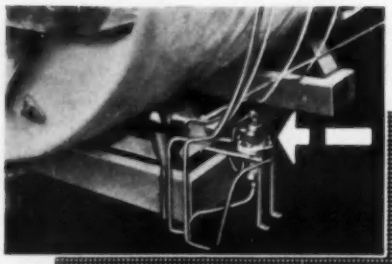

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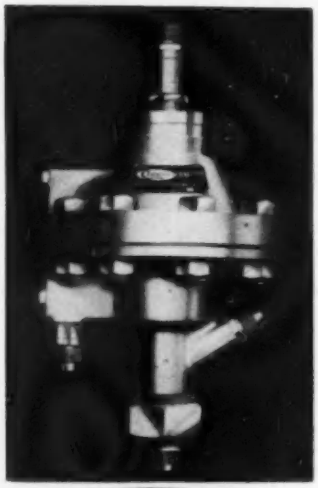

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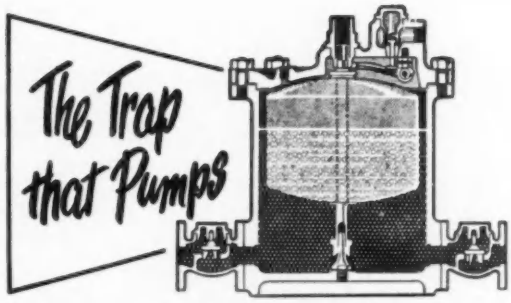

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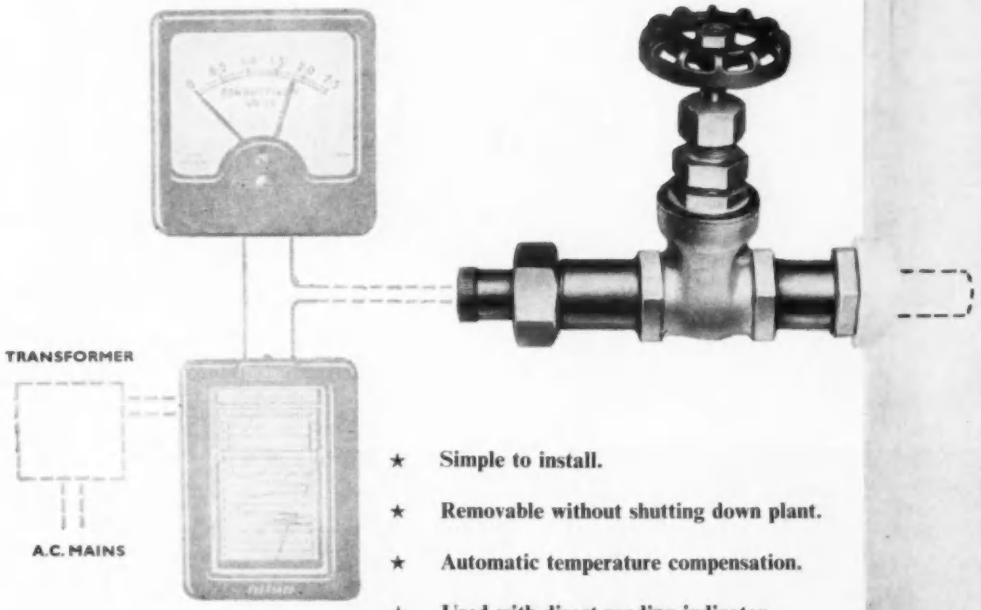

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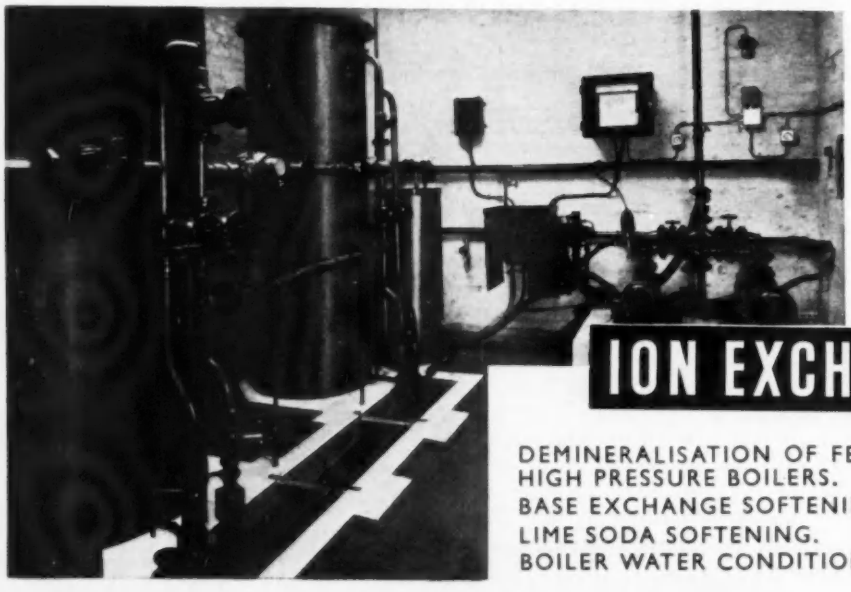

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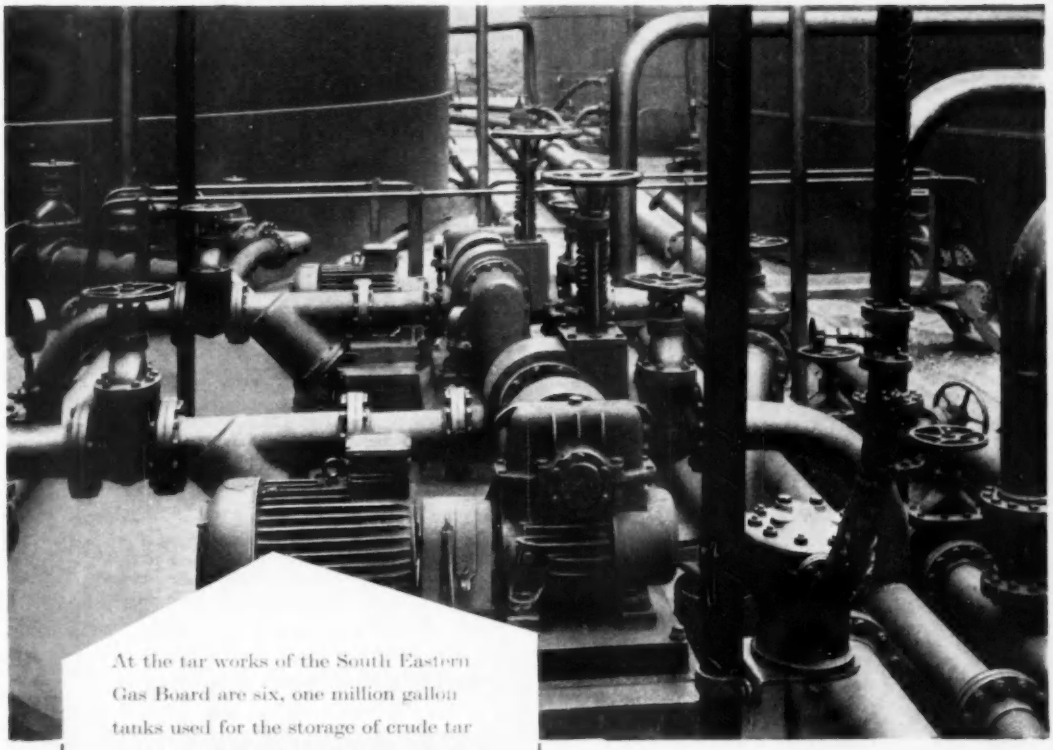

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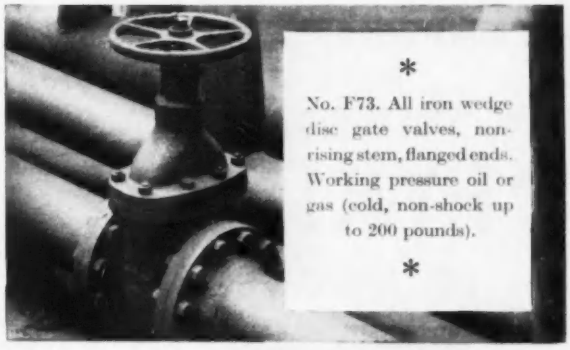

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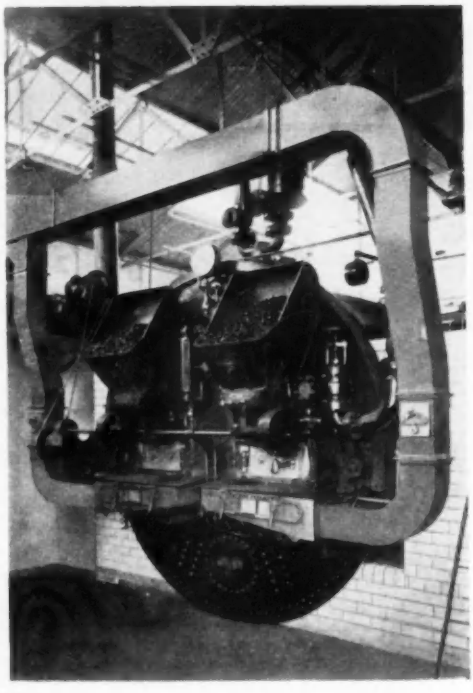

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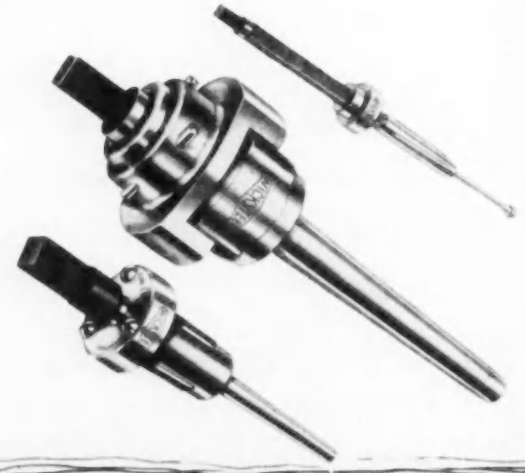

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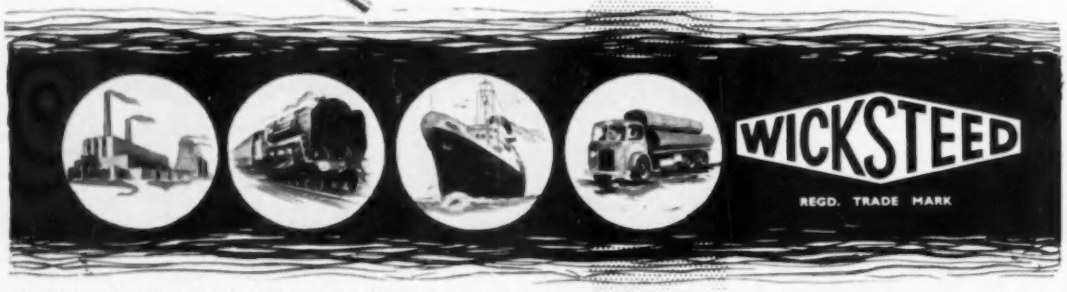

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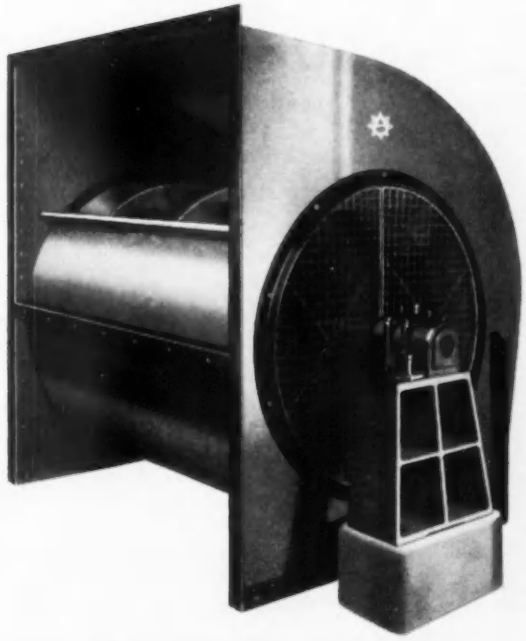

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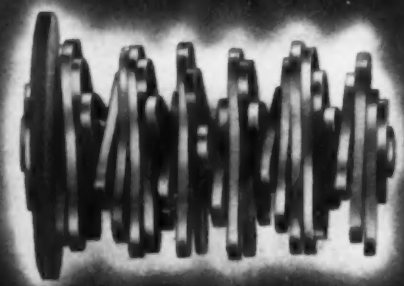

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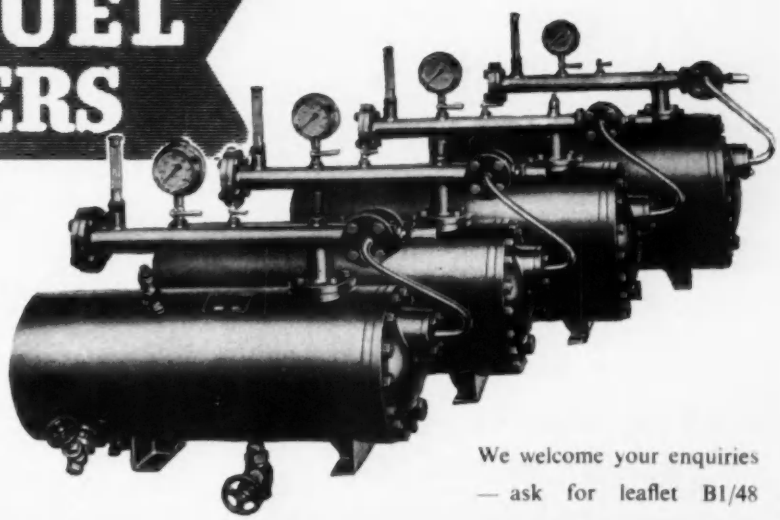

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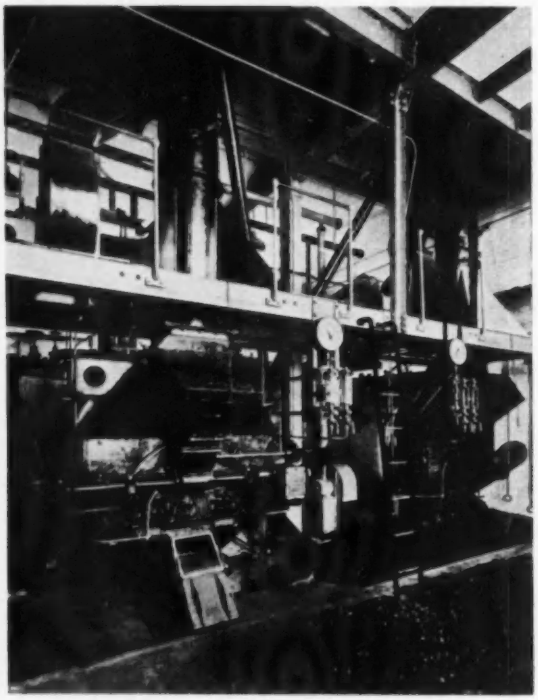

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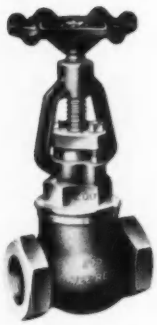

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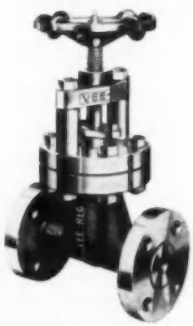

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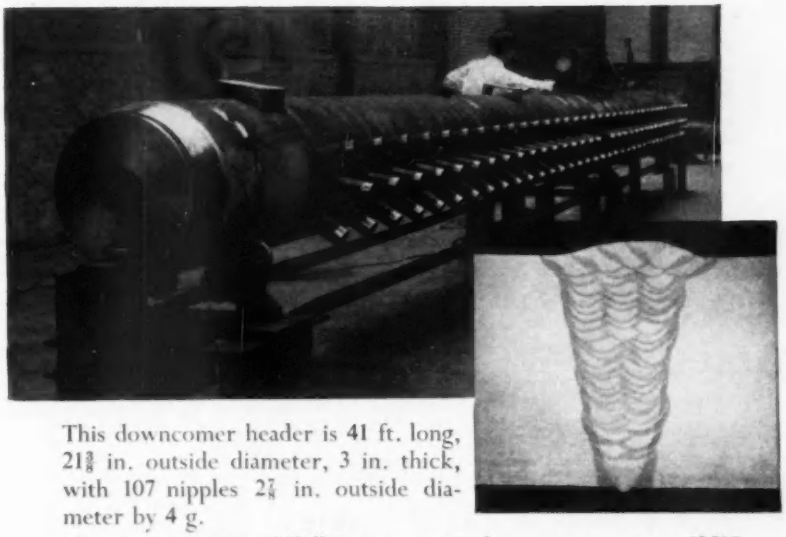

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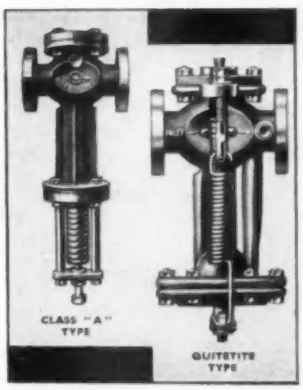

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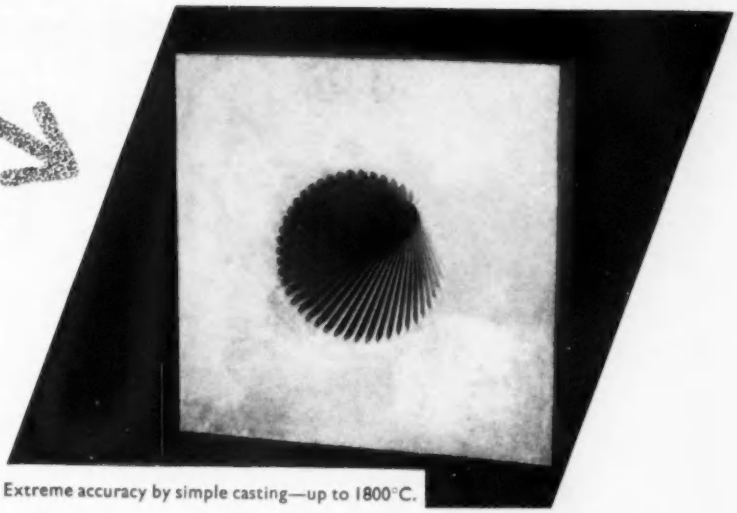

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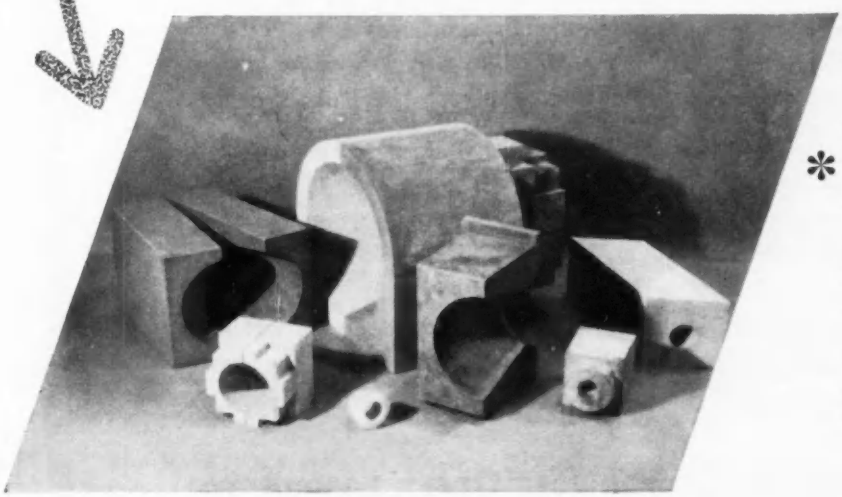

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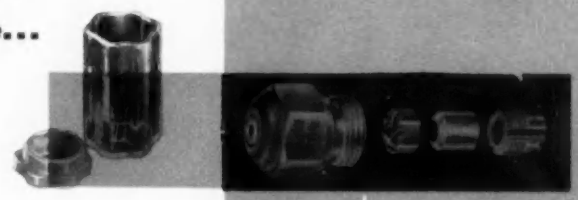

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